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The What's New magazine

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MARCH
1983

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New powerful portables

—best buy in a personal computer?

PROBE IV Ford's new wind-cheating supercar

THE GREAT CHAIN-SAW-SHARPENING DEBATE

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av. per cigarette, FTC Report DEC. '8

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The What's New magazine

MARCH 1983
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COVER CONCEPT BY W. DAVID HOUSER, PHOTO BY GREG SHARKO

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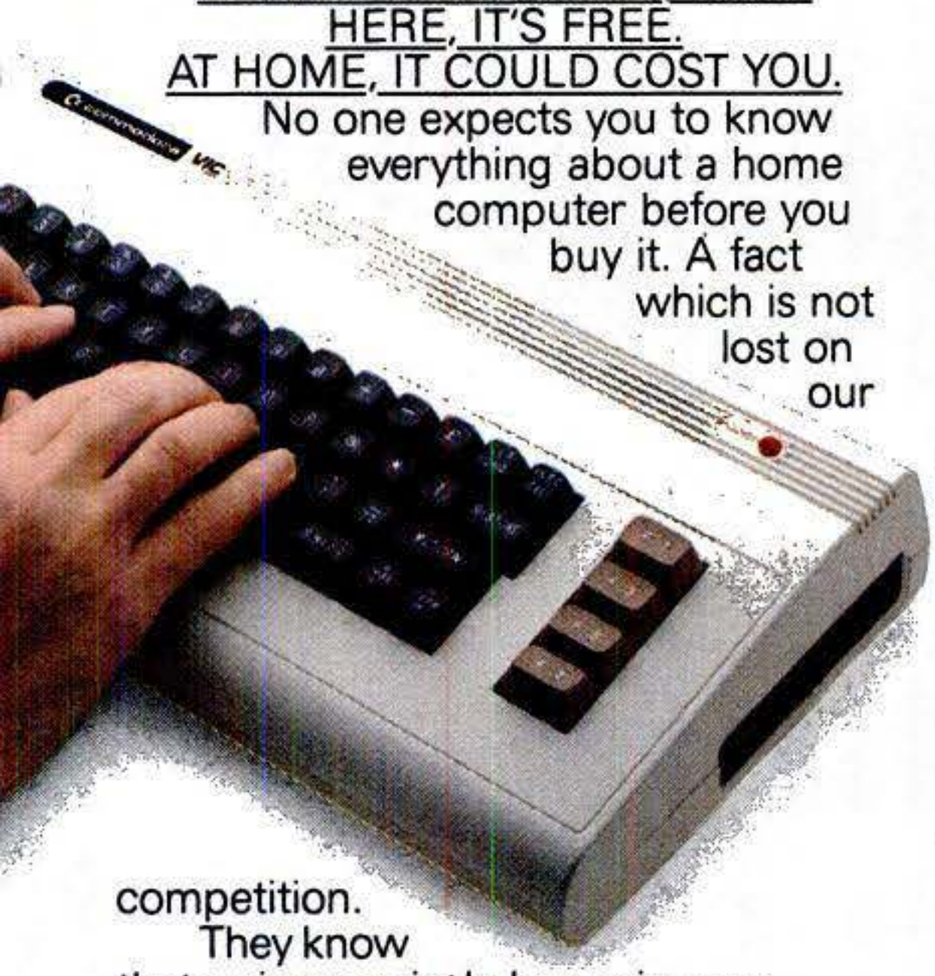
HOME IS THE LAST PLACE YOU SHOULD LEARN ABOUT A HOME COMPUTER.



WANT TO LEARN SOMETHING ABOUT HOME COMPUTERS? HERE, IT'S FREE. AT HOME, IT COULD COST YOU.

No one expects you to know everything about a home computer before you buy it. A fact which is not lost on our competition.

They know that an impressively low price can divert your attention from some depressingly cheap features. So that you won't know what you may be missing with their home computer until after it's been in your home for a while.

At which point, naturally, it'll cost you to change your mind.

IT'S EASY TO TELL THE DIFFERENCE.

Fortunately, you don't have to be a computer engineer to tell what makes the Commodore VIC 20™ superior to the competition. All you have to do is take advantage of three of your five senses.

Use your sense of vision and read this comparison chart. You can see in black and white where two of our major competitors have skimped. Use your sense of touch in the store. You'll feel the VIC 20's superiority immediately. It feels a lot more expensive than it is.

If these two senses don't convince you that the VIC 20 offers more for the money than any other home computer, simply rely on common sense.

NOW THAT YOU KNOW HOW EASY A COMMODORE HOME COMPUTER IS TO OWN, FIND OUT HOW EASY IT IS TO EXPAND.

One thing about home computers that you're bound to discover at home is that, once you learn what they can do, you'll want them to do more and more. To do this, you may need accessories called peripherals. These let you get more out of a home computer by letting you put more into it.

They include items like cassette recorders and disk drives to input data, modems for telecomputing and printers. And all VIC 20 peripherals are fully compatible with the powerful Commodore 64™ personal computer.

PLAN AHEAD.

When you start looking at your first home computer, you may think it's too early to start planning to add peripherals. If that's what you think, you're once again playing right into the hands of our competitors.

Because once they've gotten you to buy their home computer, for what seems to be a reasonable price, they have you hooked on their system.

The costs of which, if you'll examine the chart below, can really start getting unreasonable. For example, while these computers may seem to be close to the same price to start, an expanded system can cost you twice as much with TI or Atari as with the Commodore VIC 20 or Commodore 64.

EXPANSION COSTS	VIC 20™ or COMMODORE 64™	TI99/4A®	ATARI 400®
BASIC	Included	Included	$59.95
Peripheral Expansion System	Not Necessary	$249.95	Not Necessary
Disk Drive	$399.00	399.95	599.95
Disk Controller Card	Included	249.95	Included
Modem	109.95	224.95	199.95
Modem Interface	Included	174.95	219.95
TOTAL	**$508.95**	**$1299.75**	**$1079.80**

Manufacturer's suggested list prices: Prices per TI June-December 1982 U.S. Consumer Products Suggested Price List. Atari prices effective July 1, 1982 Suggested Retail Price List.

THINK OF IT AS BUYING A TOASTER.

It's easy to fill up a computer ad with RAM's and ROM's, numbers and technical jargon. But when it comes right

down to it, buying a home computer is just like buying anything else. It's important to know just what you're getting for your hard-earned money.

And we hope we've accomplished that here by telling you about the cost of expanding your Commodore VIC 20 or Commodore 64 computer.

COMPUTER FEATURES	VIC 20	TI 99/4A	ATARI 400
Typewriter Keys	Yes	Yes	No
Typewriter Feel	Yes	No	No
Color Control Keys	Yes	No	No
Graphics on Keys	Yes	No	No
Reverse Letters	Yes	No	Yes
Programmable Function Keys	Yes	No	No
Works with TV or Monitor	Yes	Yes	No
True Lower Case Letters	Yes	No	Yes
DISK FEATURES			
Capacity	170K	90K	88K

U.S.A.—P.O. Box 500, Conshohocken, PA 19428; Canada—3370 Pharmacy Ave., Agincourt, Ontario, Canada M1W2K4.

commodore COMPUTER

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Buick announces a little more wagon.

The stylish wagon you see sitting very smartly in front of its two big brothers is the new Skyhawk Limited Station Wagon.

It's the first front-wheel-drive Buick wagon. And though it's a small Buick, it's very big on traditional Buick qualities. Its seats, for example, are trimmed with the same quality cloth that adorns the Electra Park Avenue.

Due to its highly intelligent design, the Skyhawk wagon is more spacious than you might expect. With the rear seat folded down, it can carry 64.5 cubic feet of whatever you wish to carry.

So everything fits beautifully. Including you. And your cargo.

Buckle yourself up and visit your Buick dealer soon.

And put yourself into a little more wagon.

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PS READERS TALK BACK

Address letters for this column to: Readers Talk Back, POPULAR SCIENCE, 380 Madison Ave., New York, N.Y. 10017. Because of the large volume of mail, we are unable to acknowledge unpublished letters.

Notes from the underground

Congratulations to author Charles Lane and illustrator Gene Thompson for successfully condensing almost everything that needs to be said on the subject of underground construction into just four pages ["Underground Basics," PS, Nov. '82]. A couple of quibbles, though: Lane omitted the best (in my opinion) structural system available, the monolithic reinforced-concrete pour, in which a seamless roof and wall are poured at the same time. This greatly reduces waterproofing concerns. Also, the drawing does not show any perimeter insulation anywhere on the south side of the structure, which is even more important than that installed on the walls and roof.

George E. Handley
Shawnee Mission, Kan.

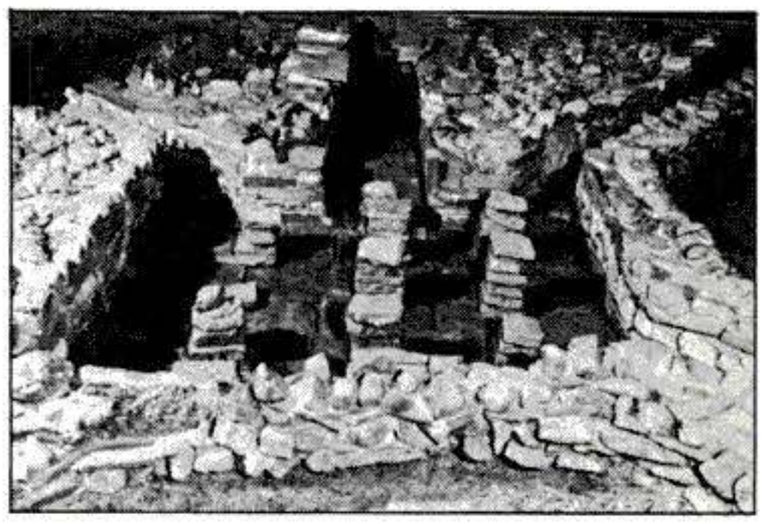
The southern edge of the slab should be insulated on the inside. Also, at least a two-foot width of Styrofoam should be under the slab along the south side to reduce heat transfer to the footing. Many of the structural and waterproofing problems discussed in the article can be avoided by building the earth-sheltered home on the surface of the ground, then banking the dirt up to (but not over) the roof on three sides. Rainwater or melting snow then runs down the banks rather than the walls. A lightweight R-30 roof is much cheaper than a soil-covered one.

John F. Strickler Jr.
Camano Island, Wash.

Charles A. Lane replies: "The south-perimeter foundation wall should be insulated as the readers suggest. Insulation placement under the floor slab, however, is a function of several parameters, including local climate and soil-moisture conditions. I agree that it is hard to improve upon a properly placed monolithic, reinforced-concrete system for structural and waterproofing integrity. Finally, the use of a well-insulated conventional roof system versus an earth-covered roof is still hotly debated among professionals. This evaluation for a particular site and location should be made by an earth-sheltering professional. Whatever design system is used, simplicity is the best guarantee against problems."

. . . do as the Romans

I just returned from an extended tour of Europe, where I saw many Roman ruins from an engineer's point of view. Among these were some well-preserved examples of third-century Roman heating systems called hypocausts. Under-the-floor,



stone-lined ducts carried heated air to all parts of a building. Sound familiar? The photo [above] of one hypocaust could easily have been substituted for one of the photos in your "Passive-Solar House with Ingenious Under-Floor Heat Bank" [PS, April '82]. Even when it comes to solar heating, there is nothing new under the sun.

James A. Chisman, Prof. of Engineering
Clemson University, Clemson, S.C.

Gang up on the sun

Jerry Smyth's solar dish supported in a geodesic frame [PS, Dec. '82] looks like a natural application for a small Stirling-cycle electrical generator. One or several units could supply a remote cabin, but why couldn't these units be ganged by the thousands in desert areas as an alternative to the large heliostat installations like the one in Barstow, Calif. ["Solar One," PS, Oct. '82]? Output per dollar might be as good, and individual units could go out and be replaced without shutting the whole thing down.

Bob Cordell, Camarillo, Calif.

Save the heat

Your article "Heat-Saving Vents" [PS, Jan.] presents a good discussion of a growing problem, indoor-air quality. People generally spend much more time indoors than out, yet little official attention has been paid to the indoor environment. One point was overlooked in the article. The infiltration rates were treated as if they were constant. They are not. Infiltration is strongly influenced by wind and by indoor-outdoor temperature difference. Thus in mild weather, the infiltration rate will be much lower and indoor pollution levels will be higher unless windows are opened.

John E. Janssen, Chairman
ASHRAE Ventilation Std. Committee
Roseville, Minn.

Most of the 20 or so kinds of air-to-air heat exchangers for houses have been de-

Continued

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PS readers talk back

[*Continued*]

signed so as not to recover moisture. A few kinds do (such as the Sharp GV-120), but there is none that can switch back and forth between modes. Yet most homes require more or less moisture depending on time of the year, number of guests, and other variables. A mode-switching heat exchanger might be made by varying a standard rotary-type exchanger: Desiccant would be deposited in the outer part of the rotor and a knob-controlled diaphragm would route the air through either the outer or inner part, as conditions dictated.

By the way, the name "air-to-air heat exchanger" is not very satisfactory. It fails to indicate that the main function of the device is to replace the old air with new air. Therefore, I propose using the name "hexar," standing for *h*eat-*ex*changer-and-*a*ir-*r*eplacer. Besides being shorter, it suggests the full function of the device.

William A. Shurcliff, Cambridge, Mass.

V. Elaine Smay replies: "Mr. Janssen is absolutely correct. Mr. Shurcliff's remarks are, as usual, provocative. For more information about the theory, design, and performance of 'hexars,' Shurcliff's book Air-to-Air Heat Exchangers for Houses *(Brick House Publishing, Harrisville, N.H.) is an excellent source."*

In-flight computing?

It's bad enough when portable-computer manufacturers show or imply that their computers are aids to the traveling executive. Now POPULAR SCIENCE starts a review of the Epson HX-20 ["Portable Computer Features Permanent Memory," PS, Dec. '82] with "settle into your airline seat," but doesn't conclude with "the flight attendant takes custody of your computer." Do you really expect the airlines to let you operate a computer, which creates much more radio-frequency interference than an FM radio, on board? If our busy executive needs to compute en route, he'll have to take the train or bus.

Alan L. Peterman, Minneapolis, Minn.

Good point. This month's cover story takes note of that limitation.

To roar or not to roar

A couple of comments about your report on the Jøtul 201 wood stove [PS, Jan.]. First, one should never "start a roaring fire" in a cold stove, as the thermal stress could crack cast iron or warp steel. Also, the implication that non-catalytic airtight stoves are unsafe is wrong. A 15- to 30-minute roaring fire once a day is all that's needed to clean out the previous night's slow-burn deposits.

Bill McClendon, San Luis Obispo, Calif.

Under the hood

Who is kidding whom? The cars in "U.S. Mpg Champs" [PS, Jan.] all have American names or (with Volkswagen) are assembled here. But when you look behind the name and under the hood, in every case you find an imported engine. Now if I am to buy an import anyway, why not have an import name on it, too?

T. Robert Hinshaw, Stratford, Wis.

Jack Keebler replies: "First, car companies are by their nature multinational, and mass-produced cars from every country and company use components supplied from outside their home markets. Second, many of the foreign companies that supply U.S. makers are owned either partially or entirely by those same American producers. Finally, it is fortunate that American makers have been able to acquire foreign-built engines. This exchange of technology gives our industry a breather while it develops its own fine small cars and small-car components."

Cable times 10

I got all excited about your item on a 120-channel decoder for cable TV ["Look and Listen," PS, Sept. '82] until I discovered that the device isn't sold to the general public, only to cable companies. Why print the news?

Sanford H. Kline, McAdoo, Pa.

John Free replies: "I should have mentioned that the cable-conversion hardware isn't marketed to the public. I included the item to let readers know about some of the latest developments in microcomputerized cable-TV hardware. If enough informed cable-TV subscribers become excited, they may want to bring about a change in their local systems (most of which use 12-channel decoders)."

Corrections and additions: We put a couple of cities in the wrong states in recent issues. Klamath Falls, large on any map of geothermal energy ["Hot Water Power," PS, Jan.], is in Oregon. And the home town of Cummins Engines ["Ceramic Diesels," PS, Dec. '82] is Columbus, Ind.

Our apologies to Northrop Corp., whose name we consistently misspelled in "Invisible Bomber," PS, Feb.

Southern California Edison Co. has canceled plans to build a 50-MW geothermal electric-generating plant at the Heber field of the Imperial Valley ["Hot Water Power," PS, Jan.]. Sources in the company say that though the project is not economically feasible at this time, SoCal Edison remains interested in geothermal power and is considering other options for commercial development.

There are two new makers of heat exchangers ["Heat-Saving Vents," PS, Jan.]: Blackhawk Industries Inc. (607 Park St., Regina, Sask. S4N 5N1) is now making what were Enercon heat exchangers. Blackhawk claims efficiency has been improved; prices remain as listed. Henderson Energy Inc. (Box 1920, London, Ont. N6A 5J4) is manufacturing residential heat exchangers. The correct address for the Air Changer Co. is 334 King St. E., Ste. 505, Toronto, Ont. M5A 1K8.

The correct address for the headlight reminder pictured in "What's New for Your Car," PS, Dec. '82, is Warren Imports, 725 Don Mills Rd., Ste. 207, Don Mills, Ont. M3C 1S7. PS

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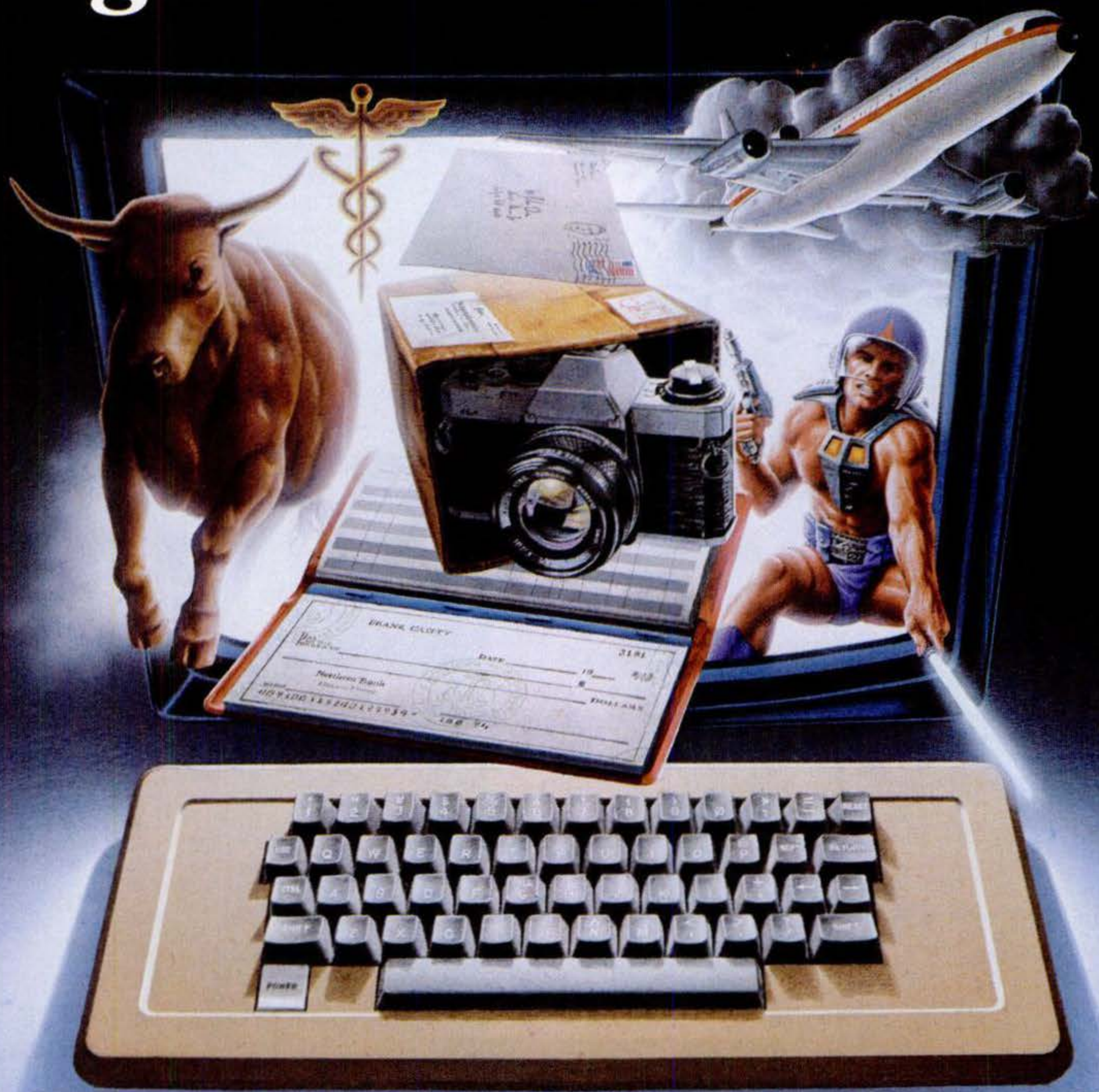

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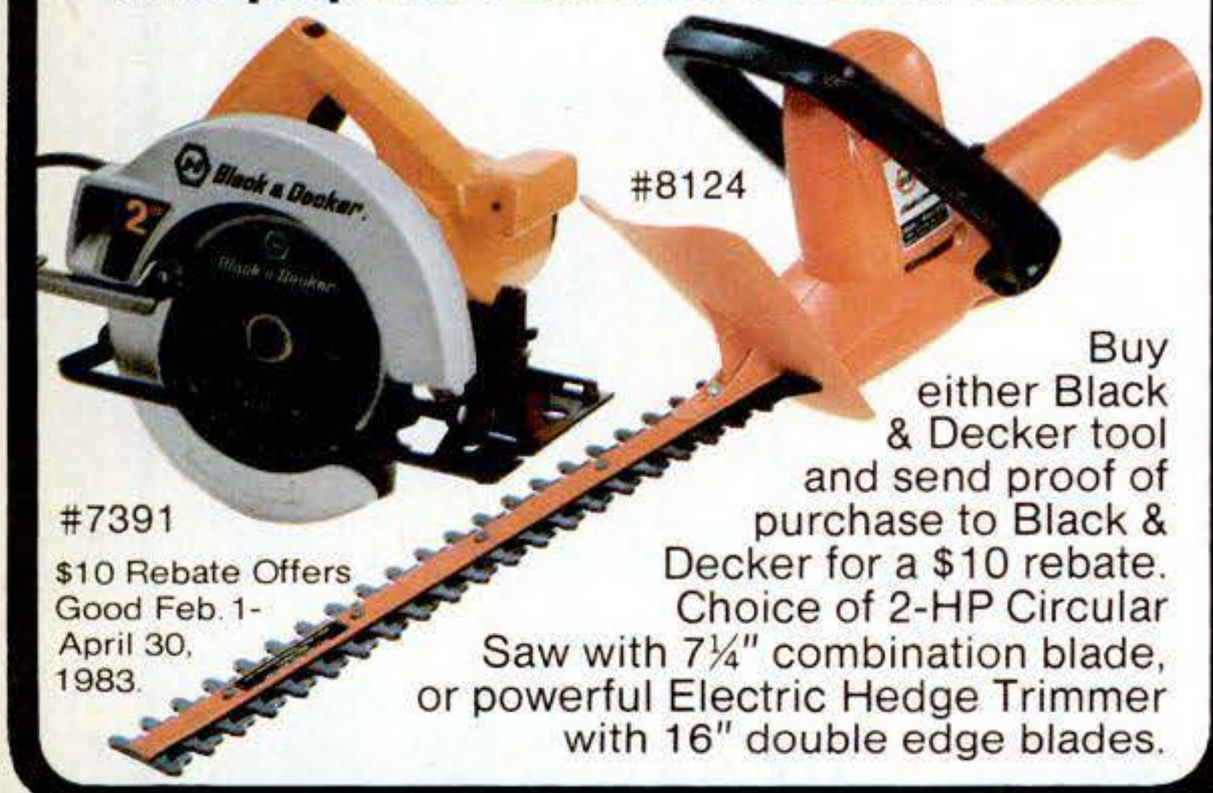

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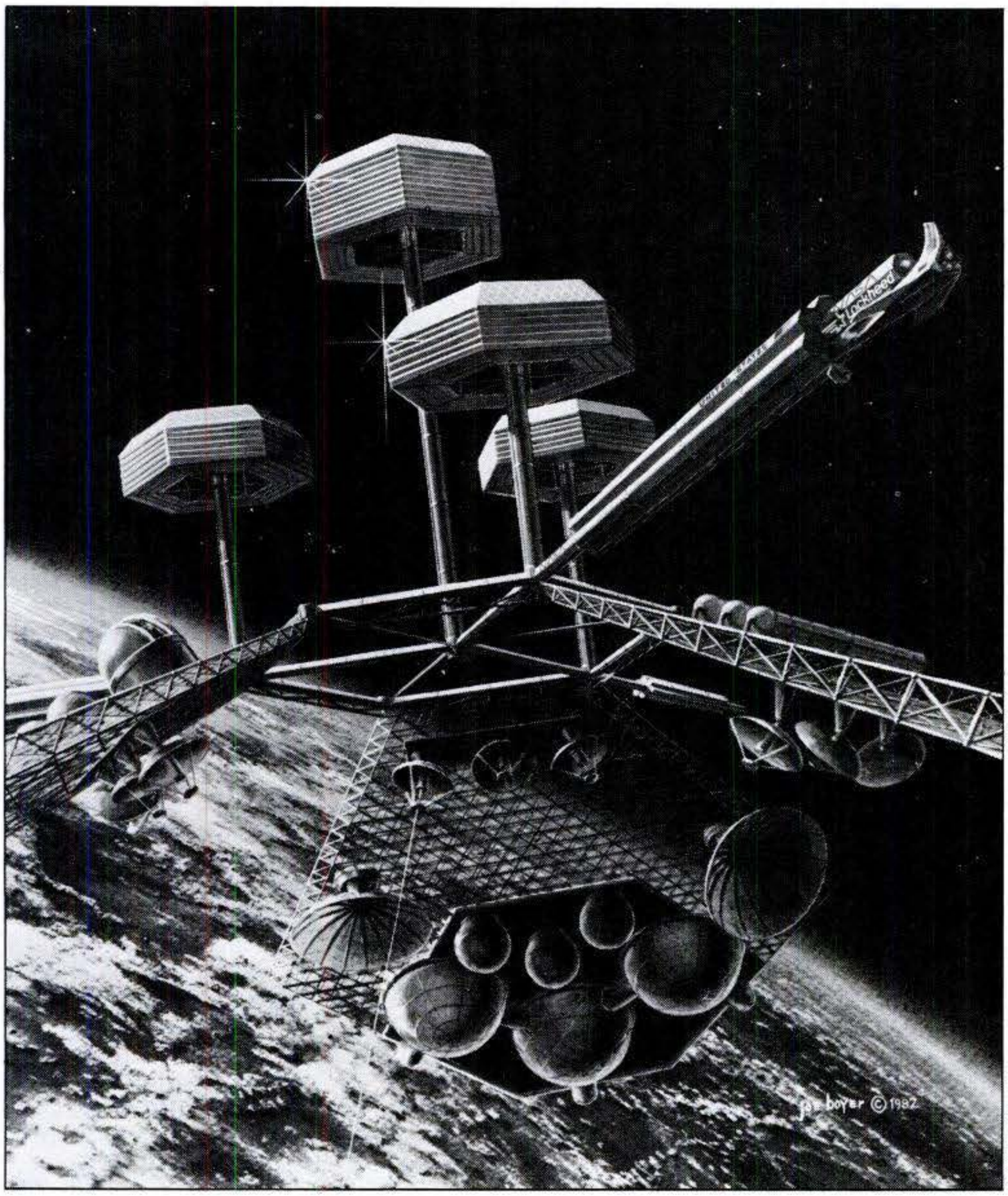
SCIENCE NEWSFRONT

By ARTHUR FISHER



Orbiting space stations

This artist's concept from Lockheed Missiles and Space Co. is just one of many space contractors' designs produced for NASA. Eventually, all the studies will be fed into a major NASA project—evaluating the decisions involved in building a shuttle-tended, permanent space station with scientific, commercial, and defense responsibilities. That step, according to a sizable chunk of expert opinion, should be this nation's next significant venture in space. In the station pictured here, the living quarters and control center have artificial gravity. There are three zero-gravity modules for scientific and other applications as well as three open-beam platforms, which are interconnected by shirt-sleeve-environment air tubes and will be used for mounting equipment such as antennas. Each platform is sited to permit unobstructed line-of-sight communications while still leaving open flight paths for shuttles and other space vehicles. The graphite-and-epoxy space columns are a Lockheed development.

Drug cuts drinking

Dr. Claudio Naranjo of the Toronto-based Addiction Research Foundation reports that the drug zimelidine, used in several European countries to treat depression, has successfully reduced the alcohol consumption of a group of normal, healthy, non-depressed but heavy-drinking men. Before the 10-week study, the 16-member group reported drinking an average of at least four drinks a day. The drug treatment reduced total consumption of alcohol by 15 to 20 percent and yielded a two-to-three-fold increase in the number of days on which no drinks at all were taken. Dr. Naranjo cautions that while this result is very exciting, it is still the result of a limited, short-term experiment. There is as yet no evidence, he says, that zimelidine could be effective in the treatment of alcoholics.

Strategic metals from waste

Researchers at Battelle's Pacific Northwest Laboratories are investigating a method of extracting platinum-group metals of immense strategic value from spent reactor fuel as part of the packaging of such wastes for long-term disposal. The metals include palladium, ruthenium, and rhodium, which are created in significant quantities inside a nuclear reactor during the fissioning of reactor fuel. According to George A. Jensen, a senior research engineer at Battelle, the metals are used by the military, industry, and medicine for communications equipment, electronic components, laser mirrors, aircraft engines, and infrared lenses, and as catalysts for the production of gasoline and nitrogen fertilizers. The U.S. now imports almost 99 percent of the strategic platinum-group metals it consumes; the Soviet Union and South Africa are the primary sources.

Tiny diode laser

A new, high-power semiconductor laser, smaller than a grain of salt, has been developed by RCA. According to the company, it will soon replace gas lasers in applications such as optical-disc data storage. In the photo below, inventor Dan Botez of RCA Labs holds the new laser while the TV monitor at his right shows the pinpoint of light it produces, magnified 3,000 times. Called a CDH-LOC diode laser, it is fabricated by a single-step deposition of layers of gallium arsenide and aluminum gallium arsenide over grooved gallium arsenide substrates. The acronym stands for (hold on now) constricted double heterojunction large optical cavity. The device could also prove useful in high-speed printing and fiber-optic communications.

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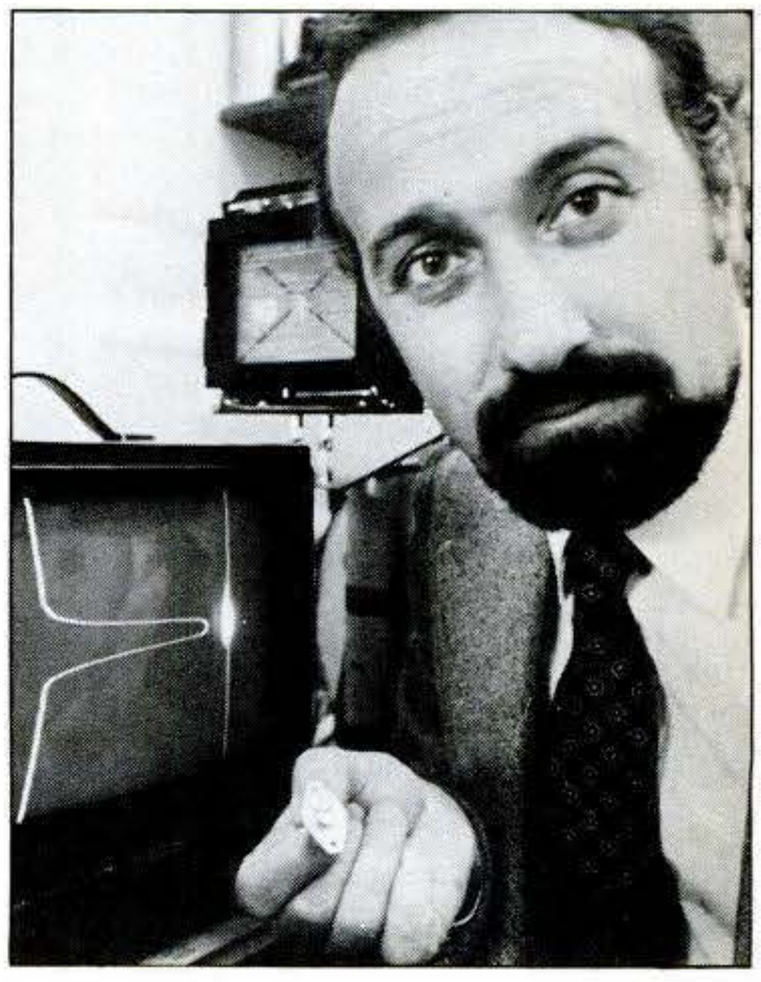

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[*Continued*]

Fusion-reactor tests

Until now, most fusion experiments have aimed at demonstrating the scientific feasibility of nuclear fusion as an energy source. But beyond that stage lie truly formidable engineering problems—devising systems and materials that will withstand the incredible heat and stress within a working fusion power plant.

Now Westinghouse Electric Corp. and Argonne National Laboratory have begun using the first large-scale facility to test fusion-reactor components. It bombards sample materials with an intense electron beam to simulate fusion temperatures and stresses. In the photo above, a technician is monitoring operations through the porthole in a vacuum chamber.

Super-strong ice

For the first time, experimenters have subjected water ice to extremely high pressures at very low temperatures, and the results cast new light on the ice moons of our solar system. Scientists from Lawrence Livermore National Laboratory and the U.S. Geological Survey conducted the tests at LLNL. They showed that ice under extreme conditions—as cold as −196 deg. C (−320.8 F) and under pressure as high as 50,000 psi—was up to 300 times stronger than originally believed. To perform the tests, William Durham and Hugh Heard of LLNL and Stephen Kirby of USGS placed a cylinder of ice one in. in diameter and 2.5 in. long in a pressure chamber connected to a compression piston and strength sensors. Each sample was cooled to a given temperature, then pressurized by pumping an inert gas into the chamber. Then the cold, pressurized samples were slowly compressed by the piston. The creep, or deformation, of the compressed ice and its flow strength were measured continuously. Previous ice-flow strength values had been extrapolated from earlier tests made at relatively low pressures and high temperatures. "The colder you get, the bigger the error is," says Durham.

The significance for such ice moons as Jupiter's Europa, Ganymede, and Callisto? "Our results increase the chances that liquid water exists far below the ice surfaces of these moons," says Durham. The stronger the ice, the less likely water is to flow toward the moon's surface and carry away heat from the core.

Largest something-or-other

Astronomers working with radio telescopes some 1,500 miles apart have identified what the National Science Foundation says is the largest known structure in the universe. The find is a single, enormous super-cluster of galaxies stretching from horizon to horizon, a string at least 700 million light-years long at an average distance of 200 million light-years from Earth. The astronomers are Dr. Riccardo Giovanelli of the National Astronomy and Ionosphere Center near Arecibo, P.R., and Dr. Martha P. Haynes, assistant director of the National Radio Astronomy Observatory in Green Bank, W.Va. The observation may help refine cosmological theories on the evolution of the universe.

Solar smoke receiver

Arlon Hunt, a physicist at the University of California's Lawrence Berkeley Lab, has designed and built a solar receiver using an ingenious and novel approach.

A solar receiver works by focusing sunlight, usually concentrated by mirrors or otherwise, onto a moving fluid, which absorbs solar energy and becomes hot. The fluid then transfers the heat outside the receiver for conversion to electricity or for direct heating uses. The working fluid is either a gas, such as air or helium, or a liquid such as water or oil. But the working fluid in Hunt's device is actually a gas-solid mixture—an airstream wafting along tiny particles of carbon black.

The device is called SPHER, for Small Particle Heat Exchange Receiver. It stands five ft. high, is four ft. wide, and is made of stainless steel and aluminum with an eight-in.-wide window at the bottom. In a recent test, 550 mirrors, each about three ft. in diameter, were arrayed beneath the receiver to reflect sunlight through the window with a concentration of 2,000 suns. When the air-carbon mixture is pumped through the SPHER, the particles quickly absorb solar energy, heating the airstream to about 1,380 deg. F. Key to the efficiency of the process is the enormous surface area provided by a very small mass of submicron carbon particles. The particles absorb heat so quickly and transmit to the air so effectively that the walls of the vessel remain relatively cool.

The receiver has generated 30 kilowatts of thermal power, enough to drive a turbine and produce 10 kW of electricity. With minor modifications, its inventor says, a similarly designed receiver could generate as much as 300 kW of thermal power—enough to serve a small community or run a fair-sized ranch. In a large plant, he says, only 11 lbs. of carbon per hour would be needed to operate a 10-MW turbine, which could supply electricity to 10,000 homes. PS

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DETROIT REPORT

By JIM DUNNE

Better bird

Ford has taken the back seat to GM in the personal-luxury-coupe field long enough. It is now determined to restore the Thunderbird as the dominant car in that field. In addition to the new T-Bird's aerodynamic styling, Ford has a turbo version that is quicker than anything the competition has available in its class. The car uses a 2.3-liter (140 cu. in.) turbocharged four-cylinder engine with fuel injection. But with a difference: The injection system is a multiport type that gives more power than the throttle-body injection found on many of the newer engines in the industry today. The turbocharging is different, too. It is set up to provide a minimum level of boost at the intake manifold, eliminating the lag you find in older types.

Ford is talking about zero-to-60-mph times in the nine-second range, which makes the turbo coupe one of the fastest Thunderbirds ever. To handle the additional power, the rear suspension has two extra shock absorbers set horizontally behind the axle. They dampen the "give" in the axle in the fore-and-aft direction and prevent axle windup when the car accelerates under full power. The results are impressive, as I noted in a sample drive on Ford's test track last fall. Look for performance buffs to hail this model as Ford's best effort this year.

Modular four

That is the description of the new variable-displacement 1.4-liter (85.4 cu. in.) four-cylinder engine developed by Mitsubishi. Normally, the engine runs on all four cylinders, but it can be switched to run on only the outside two. Oil pressure triggers the two-cylinder cutoff, which is effected by closing the intake valve. A sliding fork-shaped device releases the intake valve from the rocker arm. Mitsubishi claims there is no problem with uneven heat-up, and pumping losses due to friction and compression are reduced by 60 percent.

The engine is now sold as an option in Colt-type cars in Japan. The two-cylinder mode gives 71 mpg at a steady 37.5 mph, probably its best speed for economy.

G-coupe quandary

GM was planning front-wheel-drive versions of the G coupes—Monte Carlo, Grand Prix, Cutlass Supreme Regal—for 1984. Now at least two of those—probably Monte Carlo and Cutlass—will continue with rear-wheel-drive models of the current size. That's the confusing story coming out of GM's planning center. It appears that Chevy wanted to break with the corporate competitors and keep the present Monte Carlo (with styling revisions) as an exclusive. Now Olds is having second thoughts about abandoning its top-selling Cutlass coupe and may join Chevy in keeping rear-wheel-drive.

Trucks can't stop

Comparing stopping distances between cars and trucks, a Pennsylvania State University researcher found some answers to questions that have long puzzled automotive engineers. It's well known that trucks take longer to stop. Two factors hurt truck-tire stopping power: running temperature of the tire and the rubber compound. The temperature of the tire depends to a great extent on its pressure: the higher the pressure, the higher the temperature and the longer it takes for a tire to grab. Since truck tires typically use high pressures, they have high running temperatures where the tread and the road meet, so stopping power lessens. Triple the pressure, and the temperature triples. Also, truck-tire rubber compounds are made for long mileage, and that means hard rubber, which does not have the grabbing power of soft types. Instead of digging into the surface irregularities of a road, they skid across the top. The study found that truck tires have a 10 to 15 percent reduction in the coefficient of friction compared with car tires.

Old cars are older

Average used cars have more mileage and higher price tags than those of a couple of years ago, a Hertz survey shows. In 1979 the average used car sold had been driven 29,000 miles, was 2.86 years old, and went for $3,600. In 1982 the average price was $4,770. It was 4.25 years old and had 43,711 miles. In addition to the expected price increase, the survey shows that Americans are keeping their old cars longer and driving them farther before parting company. Maybe that's a key to the nose dive new-car sales have taken in the same years.

Made in Detroit

That may become a byword for American cars once again as the auto makers rearrange their factories to mimic the efficiency of the Japanese. Look for assembly plants on both coasts to play a smaller role in auto production. Instead, major production will once again center in the heart of the country, where there is quick access to suppliers.

The key here is *kanban,* a Japanese term meaning close proximity between supplier and manufacturer. GM is leading the way, but other auto companies are leaning to the kanban plan that groups suppliers of glass, sheet metal, and small power systems virtually next door to the final production line. Benefits include shorter inventory lines (less cost for financing goods en route) and faster quality fixes (foremen can literally run across the street and tell the supplier to stop building junk). Under kanban, parts that are made in the morning can be put into cars in the afternoon. Major drawback: no cushion. If the supplier can't deliver, there is no inventory to keep things moving.

Heat your home, run your car

That's the scenario Ford lays out for its experimental urban car, built to run on methane gas—the same fuel that heats many homes. Ford could mass-produce such a car for slightly more than it costs for a gasoline-powered car. But the cost of fuel would be "substantially less." An owner would be able to fill up from his home natural-gas supply line, but he'd need a compressor and hookup hosing. Drawbacks are obvious and ominous. They include the 2,500-psi compressor needed to pump the gas to on-board pressure levels and the possibility of gas leaks from the car's tank when parked in an enclosed area such as a garage or tunnel. On the plus side: The supply of natural gas in this country is estimated to be sufficient to last 50 to 60 years at present consumption rates.

Move back the turbine—again

GM researchers believe this glamorous power plant will remain out of the car market for the foreseeable future. According to engine specialists at GM research, the turbine engine is still 10 years or more away. And when it does appear, it will be tiny compared with turbine experiments of the past. The latest GM turbine, the AGT 6, delivers 61 horsepower and weighs only 176 pounds. Earlier research turbines delivered up to 300 horsepower.

"It wasn't my fault"

That's the first plea of young drivers who have accidents. Technically, they may be correct if they did not disobey traffic laws. But in reality, the accident records of young drivers seem to point to some share of fault: Accidents happen more often with younger drivers. A study of driver ages revealed that younger drivers tend to drive small, sporty models, and these are the very cars that lead the accident statistics. One analyst says that's why small cars are involved in more accidents—they are operated by younger drivers. The same analyst claims that smaller cars are not inherently more dangerous, since at least one fleet that switched from larger cars to compacts experienced a 50 percent drop in accidents. The more statistics are studied, the clearer it becomes that the type of driver, not car size, is what contributes more to accidents. PS

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Family sedans

Detroit's new breed for '83

By JIM DUNNE and JACK KEEBLER
PHOTOS BY GREG SHARKO

Remember when Ford, Chevy, and Plymouth built *the* standard family sedans? These cars filled just about any driving assignment. That was little more than 10 years ago, before the switch to smaller models. Today there is a new lineup of standards. These are family cars, as well, but they're lighter, with smaller, fuel-efficient engines. In many ways, however, they are just like the standards of old.

The Buick Century T Type, Chrysler E Class, and Mercury Marquis are prime examples of this new breed. As in the past, passenger comfort is a standout feature. And you can load five passengers or a weekend's worth of luggage for two and get good performance. They are quiet inside. The ride is firm and controlled. (The biggest difference is in the driving. You take more active command of the car: You have to because these sedans react more quickly and are much more maneuverable than the old guard.)

The benefits of less weight and smaller engines are better fuel economy and almost no loss in performance.

Continued

PS ratings— test report in a nutshell

The ratings are based on test results and measurements. Results should be read with the understanding that they reflect tests only on our sample cars. An excellent rating is 5 points; very good, 4; good, 3; fair, 2; poor, 1; very poor, 0.

	Buick Century T Type	Chrysler E Class	Mercury Marquis
Acceleration	5	5	5
Braking	1	2	2
Handling	2	3	1
Maneuverability	5	5	5
Quietness	4	2	3
Roominess	4	4	4
Vision	5	4	4
Entry/exit ease	3	3	3
EPA economy	3	3	3
Ride comfort*	3	3	4

*Authors' opinion

Balanced styling and handling characterize Detroit's new four-doors. Clockwise from bottom are Mercury Marquis, Buick Century, and Chrysler E Class.

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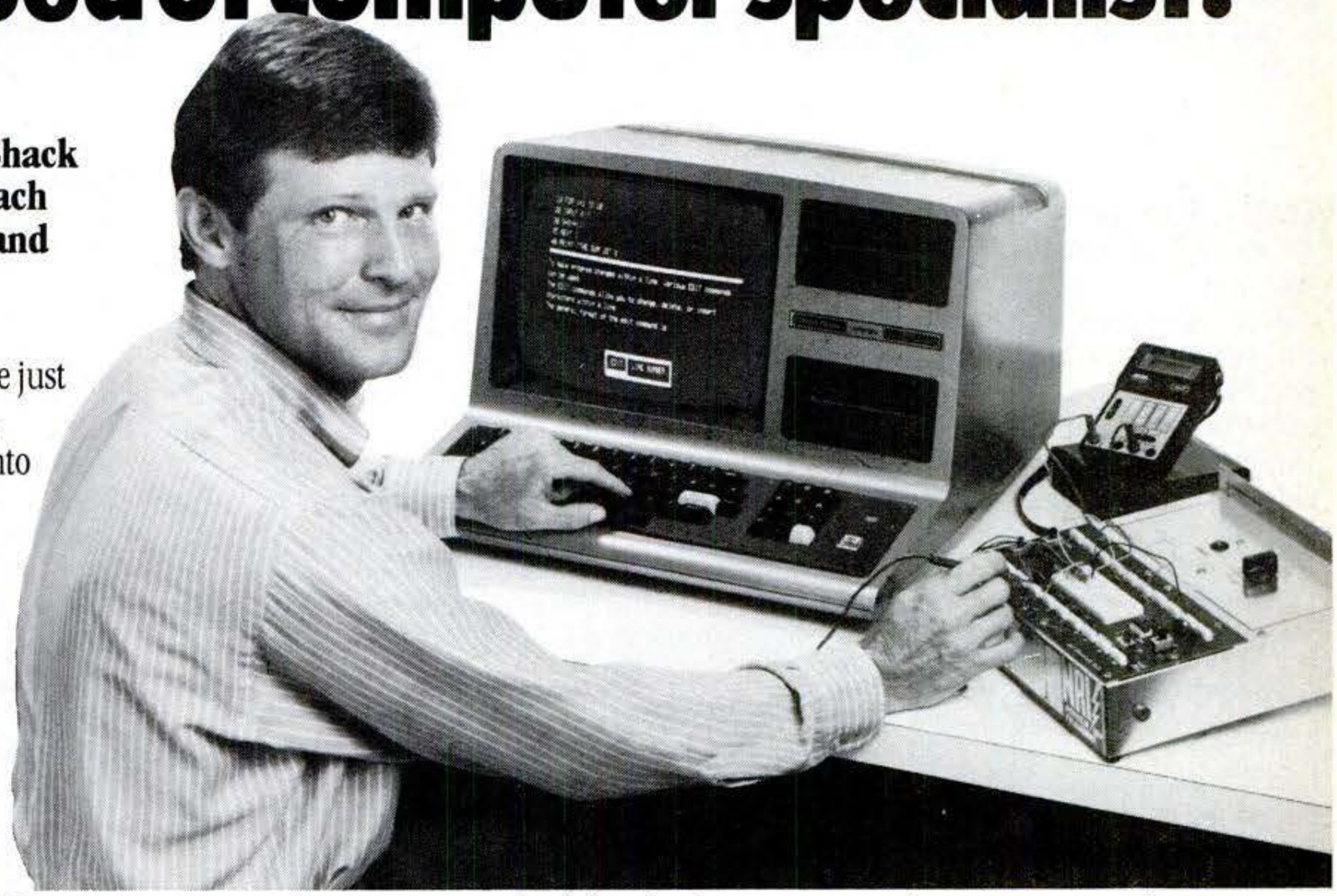

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Fuel economy is nearly doubled in the Ford and Chrysler cars over those sedans built just five years ago (see performance-comparison table). Yet each of the models easily broke 15 seconds in zero-to-60-mph runs, duplicating the performance of cars of the good old days.

One problem with the smaller cars that Detroit builds is greater passenger-compartment noise. These latest sedans show much improvement but still don't come up to the smoothness and silence of a heavyweight V8. Buick is the best in this test, getting just under top marks on the decibel meter. Marquis was a step down on the scale, while the E Class was the poorest, its four-cylinder engine probably the problem. Overall, though, the cars are easily more pleasant to ride in than smaller economy types. Noise is not a noticeable distraction at most driving speeds.

Here's how the cars measured up individually:

Buick Century T Type

"T Type" stands for a new, sporty theme at Buick. Silver and black paint and dark-gray interiors are trim items that set this model apart from the pack.

Inside Century, we found one of the most intriguing layouts of any 1983 model we've seen. The color scheme is flat-black finish with gray trim. The seats have multiple adjustments, including a pull-up thigh support. A lumbar cushion is built into the back, and side wings hold front-seat passengers snugly comfortable.

Buick describes the T Type as a "balanced performance" car for "people who like driving." There's no special engine, but the suspension is GM's famous F41, and the tires, steering, and alloy wheels are the best from Buick's parts bins.

As part of the package, the T Type has rear shock absorbers that adjust automatically to keep the bumper height constant, even when the car is heavily loaded.

Chrysler E Class

This is the stretched version of Chrysler's K-car. It has a three-inch-longer wheelbase—all devoted to more room for rear-seat passengers. It's the company's top front-drive model, and it uses a proved power train. Engine power is more than adequate. The engine's twin-shaft balancing system smooths all except the idle-speed vibrations, but the engine is not as smooth or as quiet as the V6s of the Buick and Mercury.

Fuel economy is on a par with the bigger engines; that means good but not outstanding. The gear ratios in the transmission and final drive give the E Class the best economy in city-type driving, but less than the bigger engines' during highway cruising.

E Class's interior trim is simply a dressed-up version of the Chrysler LeBaron's. A new speedometer display and more generous use of fake woodgrain trim on the instrument panel and doors mark the major differences. The seven-function computer center that runs the clock also displays the date, has a trip odometer, and relays fuel-economy information. It's an impressive piece of dash hardware. E Class will also talk back to you if you order the Electronic Voice Alert, the warning system with the most extensive vocabulary in autodom.

E Class is Chrysler's top-price front-drive car, but it needs chassis tightening and more noise control to match its two competitors.

EPA fuel mileage (mpg)

	Century T Type	E Class	Marquis
Highway	32	29	32
City	20	22	20
Calif. city	19	20	19

PS fuel-mileage tests
(steady-state mpg)

35 mph	27.2	30.8	24.9
55 mph	24.9	22.9	24.1

Mercury Marquis

Few cars have changed our opinion so dramatically and quickly as this latest luxury sedan from Mercury. We expected a dressed-up version of Zephyr, with all of the faults of the lower-priced car. Instead, we found a substantially different car, one that has all of the features you look for in family transportation. It's quiet and tight, with a reasonably firm ride, and the engine comes close to the low vibration and noise of a V8.

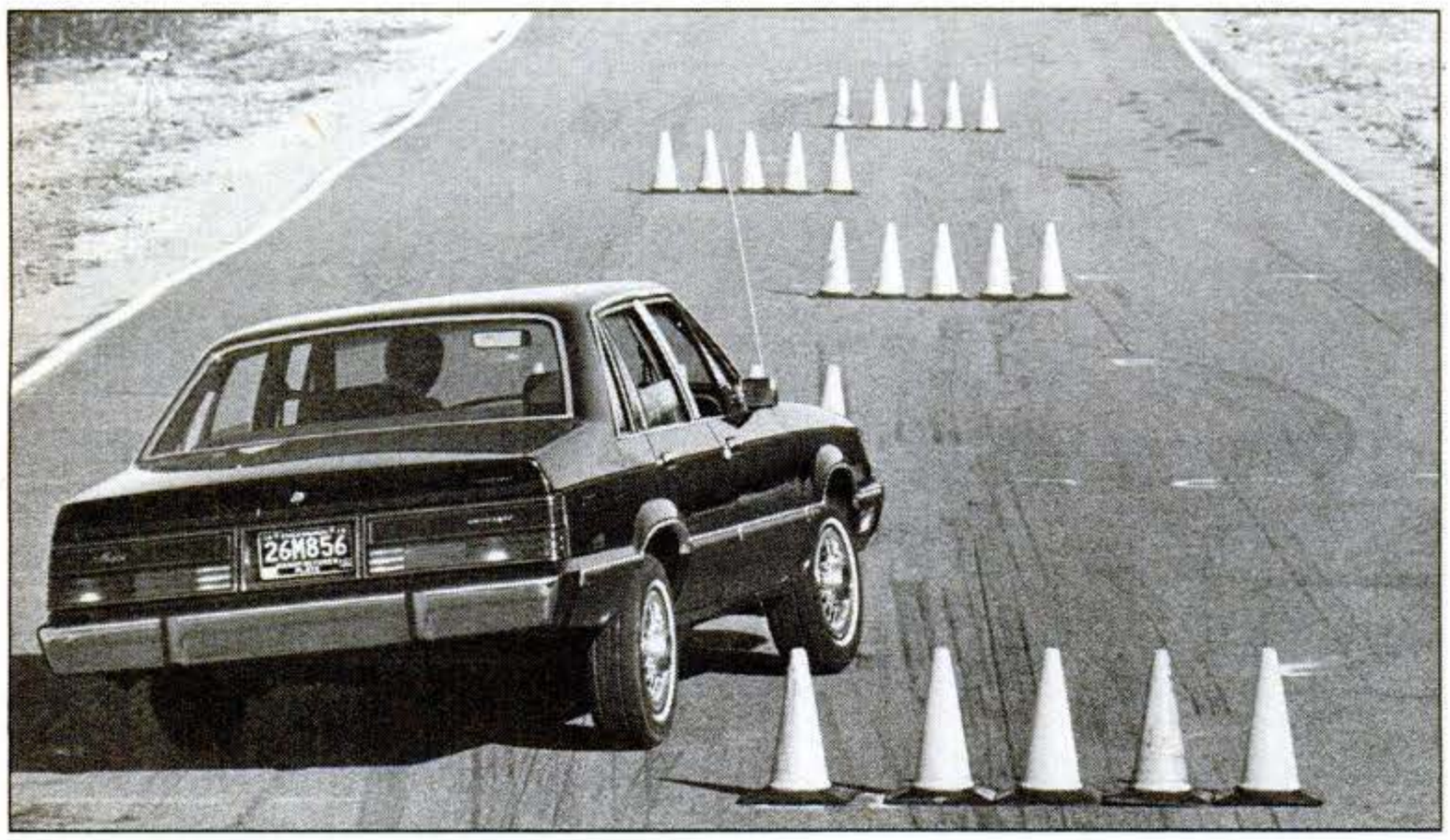
Basically, the chassis and body are taken from Zephyr. But Mercury made the proper improvements so that defects in the original car are mostly eliminated. What's left is a solid package that features many of the luxuries of big cars of the past.

Check the price breakdown on this test car for a real eye-opener. It's loaded with $4,700 worth of extras. That's an increase of 50 percent from the base price. This is another big difference from the cars of a decade ago. You could buy a complete car back then for what the extras on this mid-range model cost. Big-ticket items include $802 for air conditioning, $415 for the individual sports-type bucket seats, and $615 for automatic transmission. Note that the automatic is standard on the Buick and Chrysler, a price advantage not to be ignored.

Our choices

I like the solid feel of the Buick T Type's suspension and sure steering response almost as much as the advanced appearance of the instrument panel. The price for this fully equipped car is an added bonus when matched against the competition.—J.D.

It's almost too close to call between the Century and Marquis. If I were forced to choose, Century's handling and sharp exterior would sway my vote.—J. K.



Nitrogen-filled shocks and struts on Mercury Marquis provided good ride compliance and surprising handling dexterity.

For specs and test results, turn page

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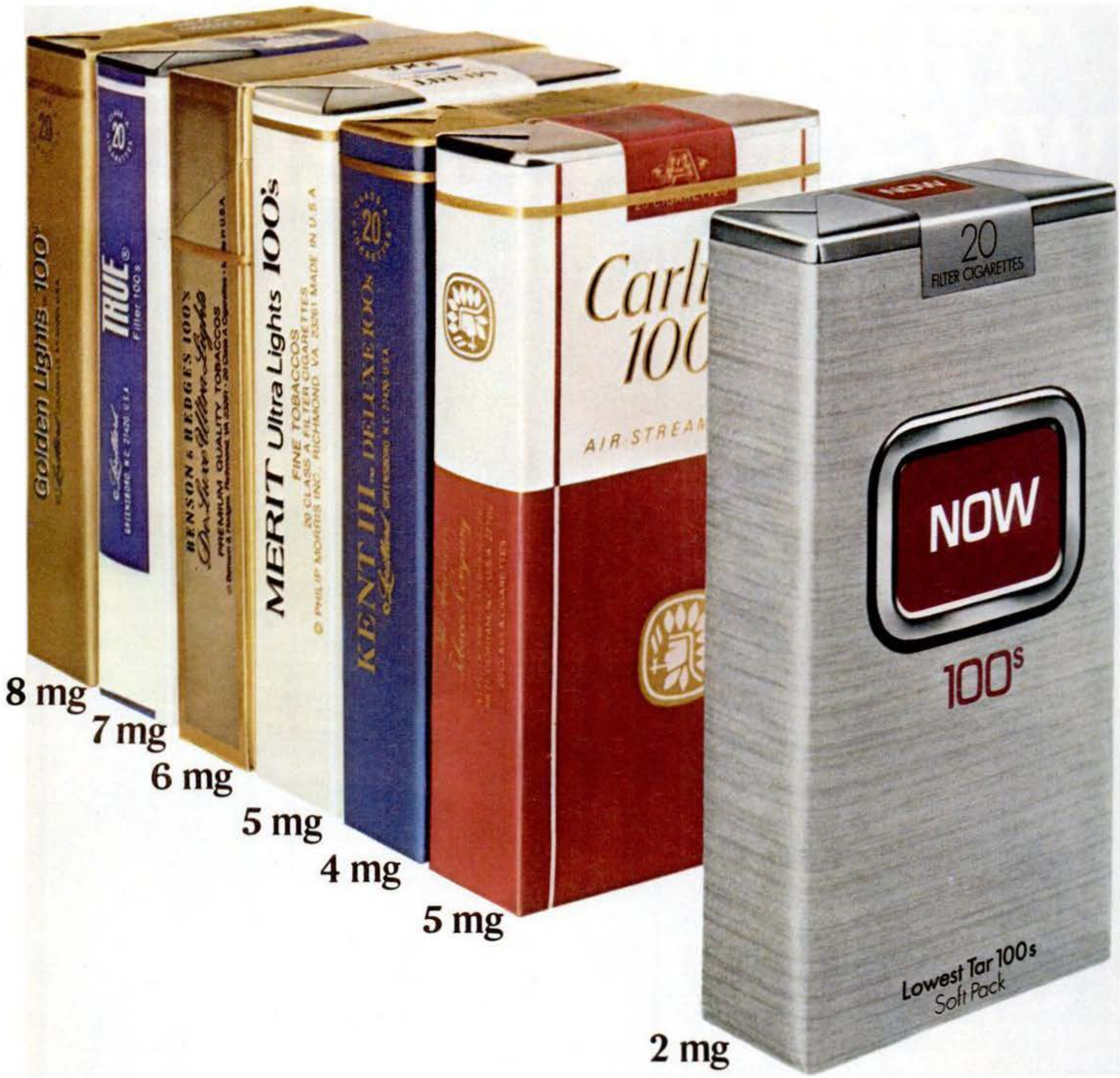

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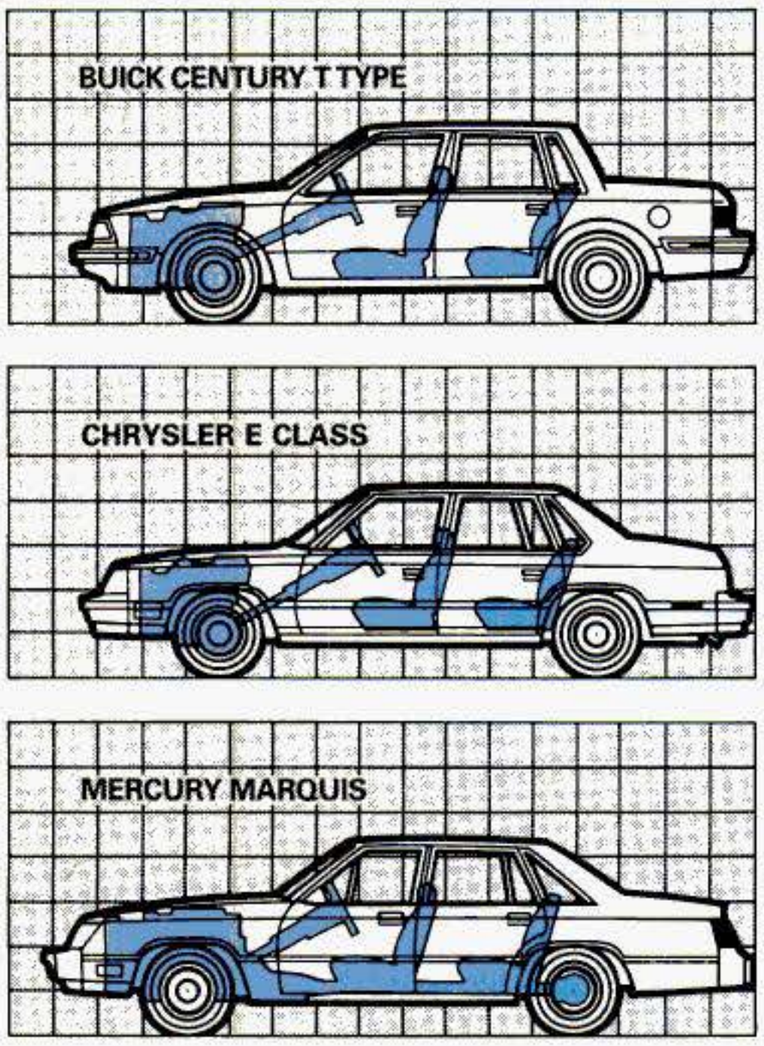

ILLUSTRATIONS BY RUSSELL VON SAUERS

Raked noses and rear decks that end abruptly are wind-cheating details that help these relatively large sedans achieve good fuel economy. Although none scored top grades on the high-speed-handling test, the front-drives got slightly better scores than the rear-drive Marquis. All were outstanding in maneuvering through cones at low speeds.

PS serviceability ratings

How easy is it to service our test cars? For example, is that heater hose clamp out in the open where it can be reached easily? To give you an approximation of how difficult it is for a typical person to perform various service operations on the cars, we examine each vehicle. Here's what the numbers mean: 1, very difficult; 2, difficult; 3, average degree of difficulty, no worse or better than most other cars; 4, easy; 5, very easy.

	Century T Type	E Class	Marquis
Checking fluid levels			
Battery	5	5	5
Master cylinder	5	3	3
Windshield washer	5	5	5
Engine oil	5	5	4
Coolant	5	5	3
Checking the engine			
Spark plugs	2	4	2
Distributor	4	4	3
Oil filter	2	3	4
Oil fill	4	5	3
Replacing hoses			
Upper radiator hose	5	5	3
Lower radiator hose	3	3	4
Heater hoses	2	3	2
Changing bulbs			
Headlights	4	2	2
Taillights	2	2	5
Front running lights	3	5	2
Front parking lights	3	5	2
Front directionals	2	5	4
Rear directionals	2	2	4
Rear running lights	2	2	4
Checking fuses	5	3	2
Spare-tire accessibility	4	3	4
Changing belts	3	3	5

Performance comparison with selected 1982 and earlier models

	Mpg (city driving)	Acceleration 0–60 mph (sec.)	Brakes 60–0 mph (hot) (ft.)	Handling (mph)	Maneuverability (mph)	Noise @ 60 mph (dBA)
1982 Chevrolet Celebrity V6	22	15.5	166	62.1	29	68
1982 Ford Granada V6	19	17.3	194	57.4	27.2	69
1982 Chrysler LeBaron 4	23	15.6	197	60.2	28	68
1981 Dodge Aries 4	24	18.1	175	63.5	27.6+	71
1981 Chevy Citation 4	22	15.9	163	60.2	27.6+	71
1977 Ford LTD V8	11	13.9	168	51.3	22.4	64
1977 Chevrolet Caprice V8	15	13.5	142	60	28.6	63
1977 Plymouth Gran Fury V8	12	15.2	143	49.9	24.6	65

Buick Century T Type, Chrysler E Class, and Mercury Marquis—dimensions, specs, and test results

	Buick Century T Type	Chrysler E Class	Mercury Marquis
DIMENSIONS (inches)			
Wheelbase	104.9	103.1	105.5
Overall length	188.4	185.6	196.5
Overall height	54.1	52.9	53.6
Overall width	67.7	68.3	71
Track, F/R	58.7/57	57.6/57	56.6/57
Ground clearance	5.7	4.7	6.3
Front head room	38.6	38.7	38.7
Front hip room	52.4	52.9	52.4
Front leg room	42.1	42.2	41.9
Rear head room	38	37.4	37.6
Rear hip room	52.7	53.5	53.7
Rear leg room (min.)	35.9	36.7	35.9
Rear knee room (min.)	1.3	1.7	2.3
Couple distance	31.9	32.8	32.6
SPECIFICATIONS			
Engine type	V6	In-line 4	V6
Displacement (cu. in./L)	181/3	156/2.6	232/3.8
Compression ratio	8.45:1	8.2:1	8.6:1
Carburetion	2 bbl.	2 bbl.	2 bbl.
Net hp @ rpm	110 @ 4,800	93 @ 4,500	110 @ 3,800
Net torque (ft.-lbs.) @ rpm	145 @ 2,600	132 @ 2,500	175 @ 2,200
Transmission	3-speed automatic	3-speed automatic	4-speed-overdrive automatic
Axle ratio	2.97:1	3.02:1	3.08:1
Tire make	Uniroyal	Goodyear	Goodyear
Tire type	Steel-belted radial	Arriva radial	Custom Polysteel radial
Tire size	195/75R14	185/70R14	195/75R14
Steering	Rack & pinion, power	Rack & pinion, power	Rack & pinion, power
Overall steering ratio	17.6:1	18.3:1	Variable, 20.03–16.05
Turns, lock to lock	3.13	3.2	3.05
Turn diameter (ft.)	38.5	35.6	39.05
Front suspension	MacPherson strut, coil springs on lower control arms	Iso-strut, coil springs	Hybrid MacPherson struts, coil springs on lower control arms
Rear suspension	Trailing arm, twist axle, track bar, coil springs	Trailing flex arm with track bar, coil springs	Four-bar link with coil spring on lower arm
Front stabilizer-bar diameter (in.)	0.94	1	0.88
Rear stabilizer-bar diameter (in.)	0.87	1	None
Trailer towing (max. lbs.)	2,000	2,000	3,500
Trailer tongue weight (max. lbs.)	200	200	500
Brakes	Disc/drum, power	Disc/drum, power	Disc/drum, power
Brake swept area (sq. in.)	288	260.6	275
Fuel tank (gal.)	15.7	13	16
Trunk space (cu. ft.)	16.24	17.1	15.1
Liftover height (in.)	23.2	29.1	29.6
Curb weight (lbs.)	2,875	2,645	3,099
F/R weight distribution (%)	64/36	65/35	52/48
Basic price	$7,952	$9,755	$8,202
Price as tested	$10,851	$13,514	$12,900
Major options (over $100) on test car	Power seat $210, door locks $120, power windows $180, rear defogger $125, A/C $775, cruise control $170, power steering $199, ETR radio $505	2.6 engine $246, rear defogger $140, tinted glass $104, dual power mirrors $113, A/C $738, travel computer $206, wire wheel covers $259, speed control $170, power seat $211, power windows $257, power locks $169, AM-FM stereo $265, premium sound $134, tilt wheel $105	A/C $802, speed control $170, AM-FM stereo $396, rear defogger $135, tinted glass $105, tilt wheel $105, V6 $309, power lock $210, trip computer $215, premium sound $151, electronic instrument cluster $289, power windows $255, auto. trans. $615, wire wheel covers $104, tires $116, power steering $218, power seats $415
TEST RESULTS			
Acceleration (sec.)			
0–60 mph	14.7	14.2	13.6
Brake test (cool) 60–0 mph			
Stopping distance (ft.)	196	173	177
Pedal pressure (lbs.)	80	60	80
Brake test (hot) 60–0 mph			
Stopping distance (ft.)	198	170	174
Pedal pressure (lbs.)	70	60	120
Interior noise @ 60 mph (dBA)	68	72	68
Handling test (mph)	58.5	59	55
Maneuverability test (mph)	28.5	28.7	27.7

TEST CONDITIONS: Ambient temperature, 45°F; relative humidity, 68 percent; barometric pressure, 28.7 inches Hg

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The foregoing is excerpted from "The Book of Bugs", AquaBug's intimidating and somewhat hostile new catalog, which is free for the asking. Send for it NOW, before the lawsuits start.

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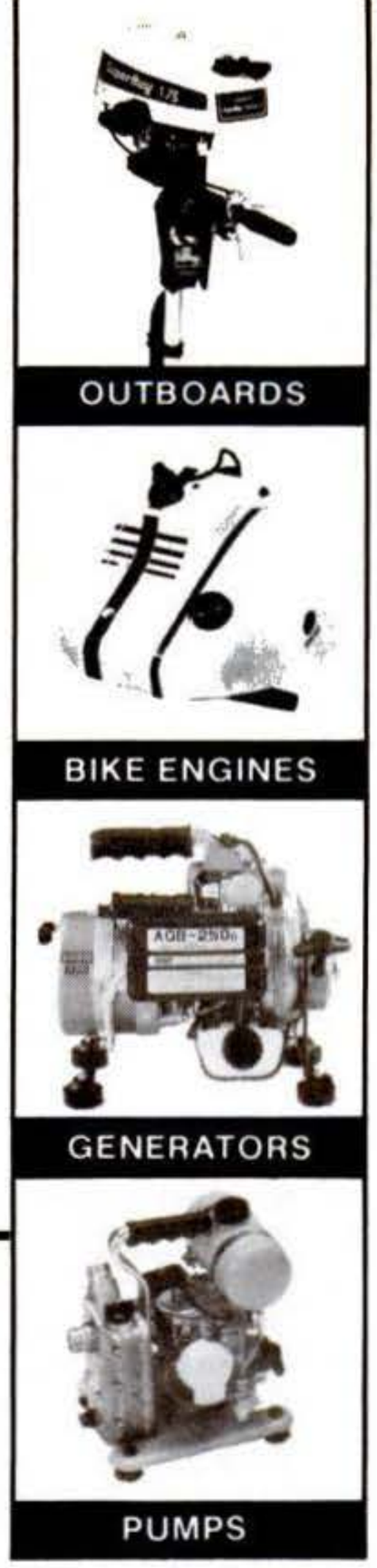

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Electric cultivator for gardens

Secret of Green Machine's effectiveness lies in two spring-steel tines that oscillate down to about 4½-in. depth.

I had always held that little electric tillers tended to be ineffective because you had to bear down so hard to get them to dig in. That is, until the makers of the Green Machine weeder-cultivator challenged me. They said their machine, which looks like an oversize frog with skinny legs, wouldn't skate and dance around.

They were right. It was smooth and steady when I tried it on some sun-baked soil that would have sent my big tiller into an adagio.

Unlike most tillers, the tines don't rotate. Instead, powered by a ⅓-hp motor, they kick back and forth, reciprocating 1,800 times a minute. This nips off weed roots.

The Green Machine weeder-cultivator isn't a soil-preparation tiller for a large garden. But it is handy for small-area cultivation.

The Green Machine weeder-cultivator is $120. It's made by HMC, 20710 Alameda St., Long Beach, Calif. 90810.—*E. F. Lindsley*

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The Radar Defense Kit

Radar warning. Hear the difference.

What Could Be Better Than Unbelievable Range?

By now, you've probably heard some tall sounding stories about how far away the ESCORT® radar warning receiver picks up radar traps. You know, the ones where they talk in miles instead of car lengths. The stories go on to say that ESCORT's superheterodyne receiving circuits provide as much X and K-band warning as you can possibly use, and then some. If you've never used an ESCORT, they may seem pretty far fetched, but most of them are true. Over hills, around corners, and from behind.

Car 54 Where Are You?

Maximum detection range is wonderful, but it's far from the whole story. In some ways, radar detectors are like smoke alarms; you want to make sure that you don't miss anything, but you don't want a lot of false alarms. ESCORT won't disappoint you. Beyond that, when a smoke alarm sounds off, the most pressing thing on your mind is: Where is the fire? Is it ahead of you, behind you, above you, or below you? In the same room, or at the other end of the house? Your senses can help you find fire, but, on the highway, you can't feel or smell radar. ESCORT is your sixth sense.

Hearing Is Believing

ESCORT reports its findings straight to your ears in a way no other detector can match. Its vocabulary includes a Geiger-counter-like pulsating rhythm that relates radar intensity in a smooth, natural, and intuitive manner, making it easy to sense the distance to radar. It can tell you if radar is ahead of you, behind you, or even traveling along with you in traffic. ESCORT also speaks different languages for each radar band. Since the two bands behave differently, the distinctive tonal differences eliminate surprises. You'll even be able to tell "beam interrupter," "trigger," or "instant-on" type radars from other signals just by the sounds they make. Ditto for radar burglar alarms and door openers. ESCORT has a lot to say, and we've developed a new way for you to get acquainted quickly.

Play It, Sam

ESCORT's instruction book contains a wealth of information. Actually, it's the ESCORT user's Bible. But, the quickest way to become fluent in ESCORT's language is to play the Radar Disc on your stereo turntable. You'll hear firsthand how to interpret what ESCORT tells you in a number of situations. We now include this special Disc with every ESCORT so you can take a test drive as soon as you open the box.

No Stone Unturned

The ESCORT Radar Disc is the latest addition to a long list of standard features. We don't scrimp on anything. Here they are: ■ Patented Digital Signal Processor ■ Different Audio Alerts for X or K Band Radar ■ Varactor-Tuned Gunn Oscillator tunes out false alarms ■ Alert Lamp dims photoelectrically after dark ■ 1/64 Second Response Time covers all radar ■ City/Highway Switch filters out distractions ■ Audio Pulse Rate accurately relates radar intensity ■ Fully Adjustable Audio Volume ■ Softly Illuminated Signal Strength Meter ■ L.E.D. Power-On Indicator ■ Sturdy Extruded Aluminum Housing ■ Inconspicuous size (1.5H x 5.25W x 5D) ■ Power Cord Quick-Disconnect from back of unit ■ Convenient Visor Clip or Hook and Loop Mounting ■ Protective Molded Carrying Case ■ Spare Fuse and Alert Lamp Bulb.

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BMWCCA Roundel: . . . "The ESCORT is a highly sophisticated and sensitive detector that has been steadily improved over the years without changing those features that made it a success in the first place . . . In terms of what all it does, nothing else comes close."

Playboy: . . . "ESCORT radar detectors . . . (are) generally acknowledged to be the finest, most sensitive, most uncompromising effort at high technology in the field."

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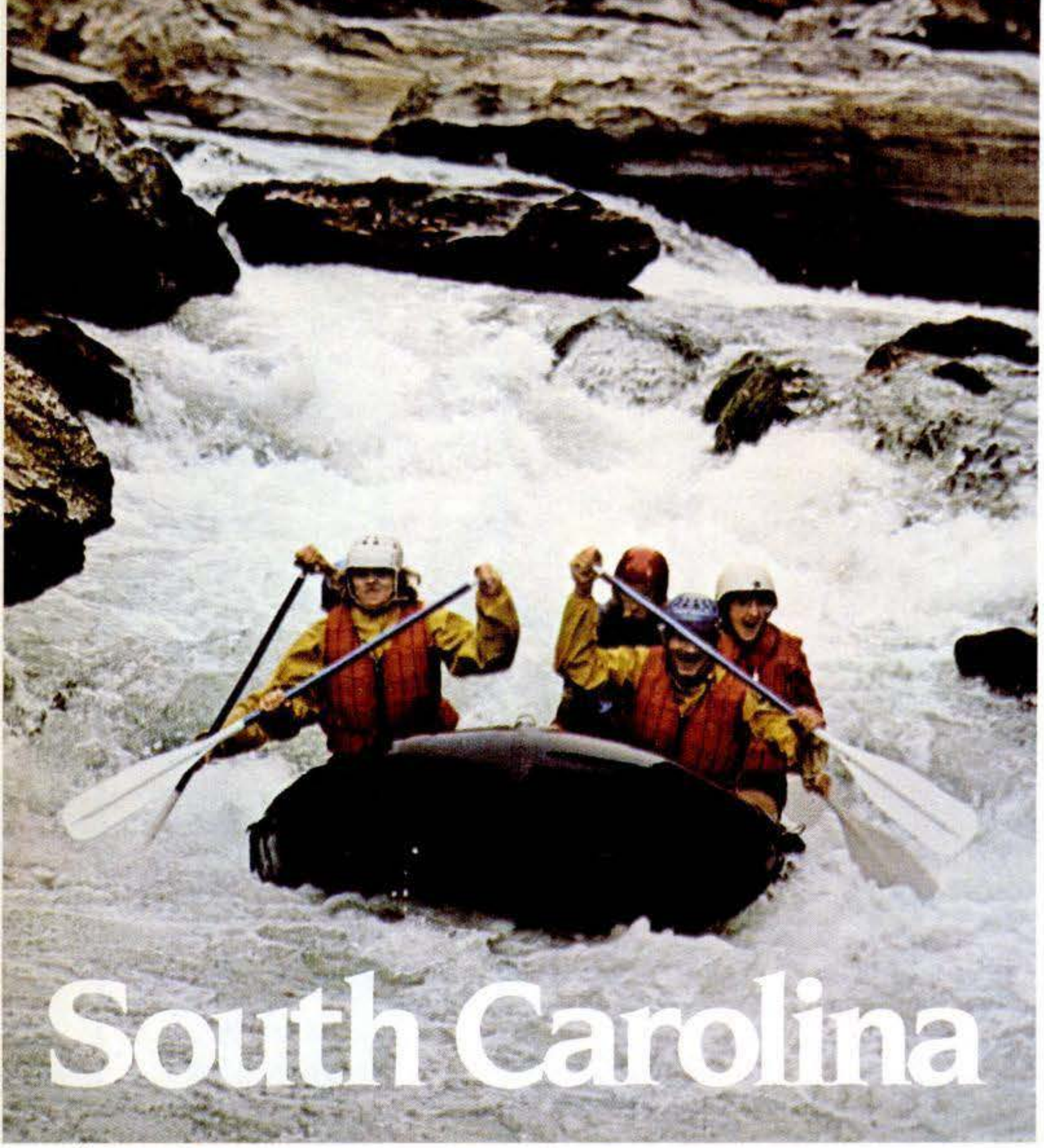
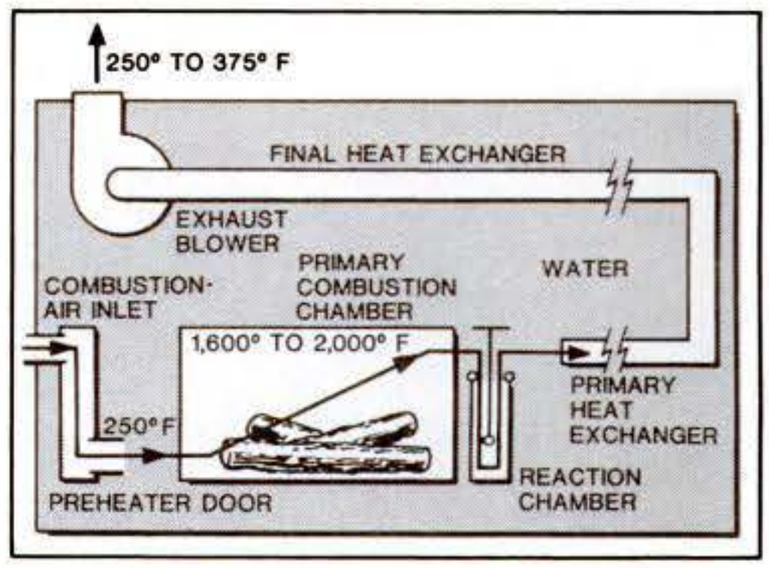


Wood-fired boiler
stores heat for days

"The homeowner spends a small part of one day firing the boiler," said Martin Lunde. "Then he doesn't have to tend to it for several days."

Lunde was explaining how his Long Term Storage Boiler solves many problems associated with wood burning. Instead of repeatedly stoking the fire, adjusting the damper, and cleaning out ashes, the homeowner tends the fire for about 2½ hours.

Inside the boiler, the combustion chambers and heat exchangers are surrounded by 1,150 gallons of water that's atmospherically vented (see diagram). Air ducted directly into the firebox generates a hot, fierce fire



that consumes about 75 pounds of wood an hour. The smoke flows into a reaction chamber that converts carbon monoxide to carbon dioxide.

"Carbon monoxide is a fuel most wood burners throw right out the chimney," said Lunde. "But this system forces a chemical reaction that extracts the most energy from the wood."

The heated gases rush through two long heat exchangers that expose maximum surface to the water. This heated water circulates through a standard fan-coil unit to warm house air.

It takes about 185 pounds of wood to bring the boiler to its operating temperature of 210 degrees F. "That hot water lasts about two days during the worst of our cold Minnesota winters," said Lunde. "In other parts of the country, it can last up to five days."

The system has performed at better than 78 percent efficiency during several years of field tests, claims Lunde and Associates (1002 Wesley Temple Bldg., Minneapolis, Minn. 55403). The 1,150-gallon boiler costs about $3,495.—*Susan Renner-Smith*

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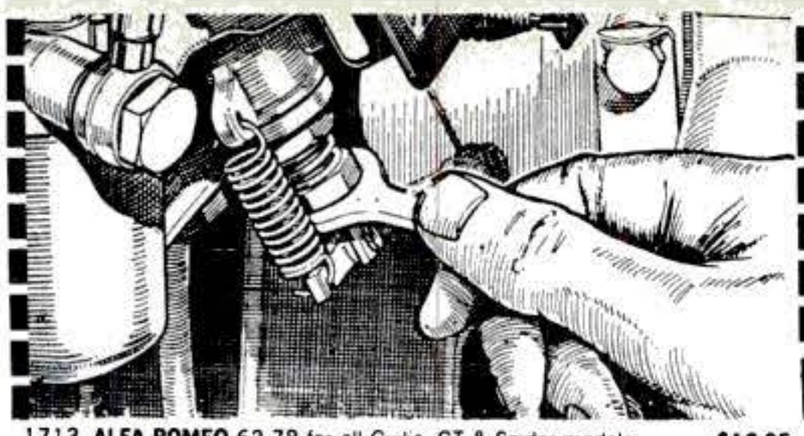

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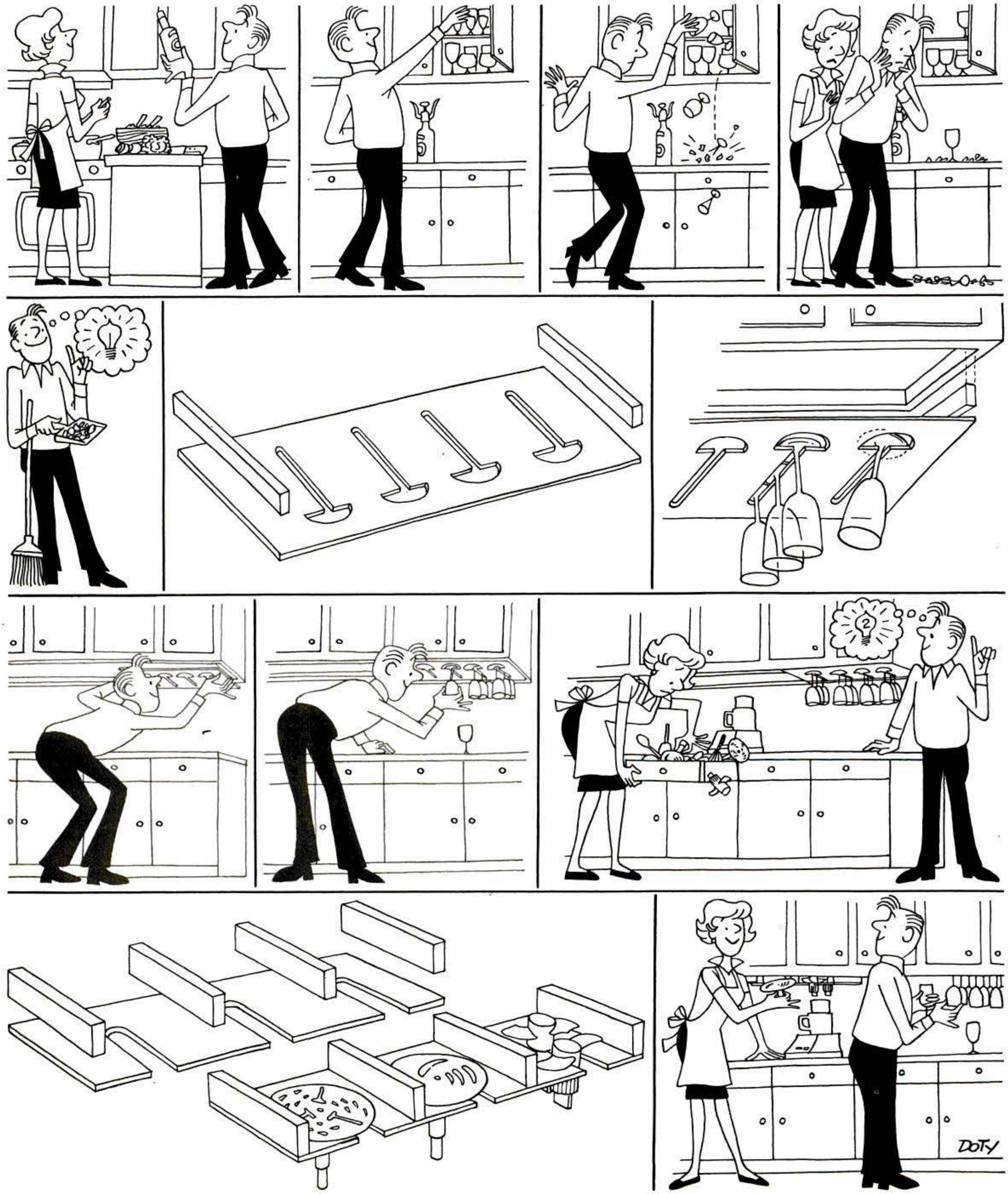
WORDLESS WORKSHOP

By ROY DOTY

A $50 check went to two contributors this month: David Watson of Long Beach, Miss., for the stemware idea and Albert Riestenberg for the food-processor-parts storage. Send your idea (with Social Security no.) to Wordless, POPULAR SCIENCE, 380 Madison Ave., New York, N.Y. 10017. Only purchased ideas are acknowledged; none are returned.



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Compact Mercedes
tackles BMW 318i and Honda Accord

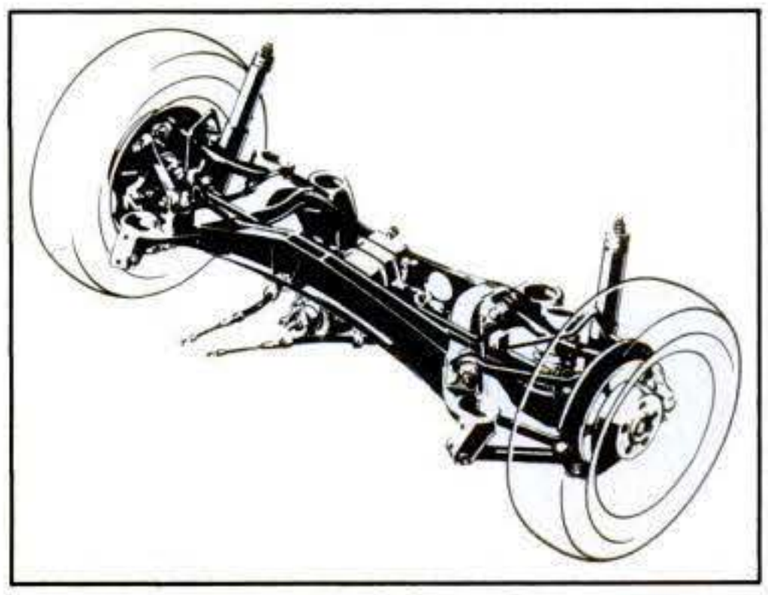
SEVILLE, SPAIN

Fifty-two new Mercedes 190s were parked just yards from where the chartered BAC-111 jet rolled to a stop at the Jerez Airport, about an hour's drive from here. I had flown in with a contingent of other writers to test this lower-priced, new-generation, compact Mercedes—designed for better fuel economy and to compete head-on with the BMW 3-series cars and the Honda Accord.

After clearing customs, I got into a five-speed 190E (the E designates fuel injection) for a short run to this Andalusian city. And for the next two days I tested a variety of 190 and 190E models. They come with four- and five-speed manual and three-speed automatic transmissions.

The cars—which did not have U.S. emissions-control packages—are lively and handle well. Ride quality of the rear-drive car has more of a big-car feeling than I expected. Mercedes engineers claim this is due in large part to a new five-link rear suspension (see drawing below). Each rear wheel is connected by a spring link; pulling, pushing, and camber struts; and a track rod. Both carburetor and fuel-injection models have 1,997-cc (121.8 cu. in.) four-cylinder engines that differ slightly.

The 190 cars are already on sale in Europe; prices start at $10,500. To be called the 220 when it goes on sale here next fall, the compact will cost about the same as the 240D, $23,000. That will include $7,000 worth of options plus U.S. safety and emissions equipment.—*H. Shuldiner*



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"SAY, SMOKEY—"

A clinic on cars by Smokey Yunick, America's most famous mechanic

50-mpg gas saver?

Someone in Canada recently invented an attachment for the carburetor that preheats the gas and vaporizes it before it enters the carburetor. He got over 50 mpg on his vehicle with a 500-cu.-in. engine. Some who have installed this device report engine problems after about six months. What do you think?

Edward Yarema, Sydney, Nova Scotia

Look for creditable proof of improvement and 50,000 miles of durability in 10 cases or so before you even think about it.

Stiff stick shift

Whenever it's fairly cold, under 30 deg. F, the four-speed transmission in my 1980 Toyota Corolla is very stiff and tends to clash. The noise disappears when the car warms up. The dealer says to add a pint of automatic-transmission fluid. Will this hurt it and decrease its life? Would it be better to switch to a lighter lubricant?

Jim Devore, Columbia, S.C.

I suggest a lighter lubricant or a plug-in heater. Don't use a light lube for hot weather and hard work. I've used straight GM automatic-transmission fluid in manual transmissions in cold weather with no trouble.

Too long between changes?

I'm pleased with Mobil I in my 1980 Citation, especially the way it starts at −20 deg. F. Now at 25,000 miles, will a simple oil change remove the dirt in the pan as the Mobil serviceman says? How about a flush or a run on detergent oil? Also, how about installing throttle-body fuel injection? Is it cost effective?

R. Ten Have, Grand Rapids, Mich.

I think 25,000 miles between changes is too long, no matter what the experts say. Throttle-body fuel injection may not be much more popular than the V8-6-4 Cadillac. Hang on for a while before you do anything drastic.

Medium-load ping

My 1978 four-cylinder Fairmont started pinging at about 22,000 miles, but only with intermediate loads. The pinging stops at full throttle. Retarding the timing two degrees, using premium fuel, and disconnecting the EGR valve hasn't helped. Why does it ping at intermediate loads and not at full throttle?

Dave Prince, Maryland Heights, Mo.

Light engine load produces high vacuum and lots of vacuum advance. You have too much automatic advance for the fuel you're using. The reason could be tied into the emissions system. It's also possible that accumulated deposits in the combustion chamber are responsible.

Altitude sickness on van

My 1979 350-cu.-in. GMC van has always refused to climb a 12,000- to 14,000-ft. mountain. It stalls and won't start until I take off the gas line and crank until the fuel runs. My other problem is on right turns after starting and warm-up. If I stop or make a right turn, it dies. After three or four such times, I have no more problems—unless I climb a mountain.

Howard O. Kirsch, Cleveland, Ohio

Climbing mountains is hard work; the engine and fuel systems get hot and vapor forms. Cool down the fuel by directing air onto the carburetor bowl with some air-duct hose. Look for exhaust heat getting to the tank or fuel lines; low fuel pressure also aggravates the problem. A flexible line works better than a steel one around heat. The stalling is a choke, EGR-valve, or carburetor-air-temperature-control problem. The right-turn stalling is a carburetor-float problem.

Rebuilds engine; no oil pressure

After completely rebuilding my 283-cu.-in. Chevy engine—doing a rebore, setting cam and crank to specs, installing new bearings, oil pump, and pistons—I'm only getting 10 lbs. of oil pressure. I took the engine apart and checked again, and it's no better.

Gregory Anderson, Minneapolis, Minn.

You probably left out the Welsh plug at the rear main bearing. It's internal, but look at another block and you'll see what I mean. Wrong lifters can also do it: If the relief sides of the lifters are machined differently, they can bypass oil to the pan.

Rebuild at 200,000 miles?

At 124,000 miles I had extensive engine work done on my 1971 Valiant Slant Six. Now I've driven it another 35,000 miles and it seems to be in good shape, including the front end. My question: Say I get another 35,000 miles out of the engine, is it a candidate for more engine work?

Dwight Blackwell, Tucson, Ariz.

Assuming the body is okay it may be cheaper to keep the old car, but do not patch. When a problem develops, completely recondition that equipment. The hooker might be that you are unable to

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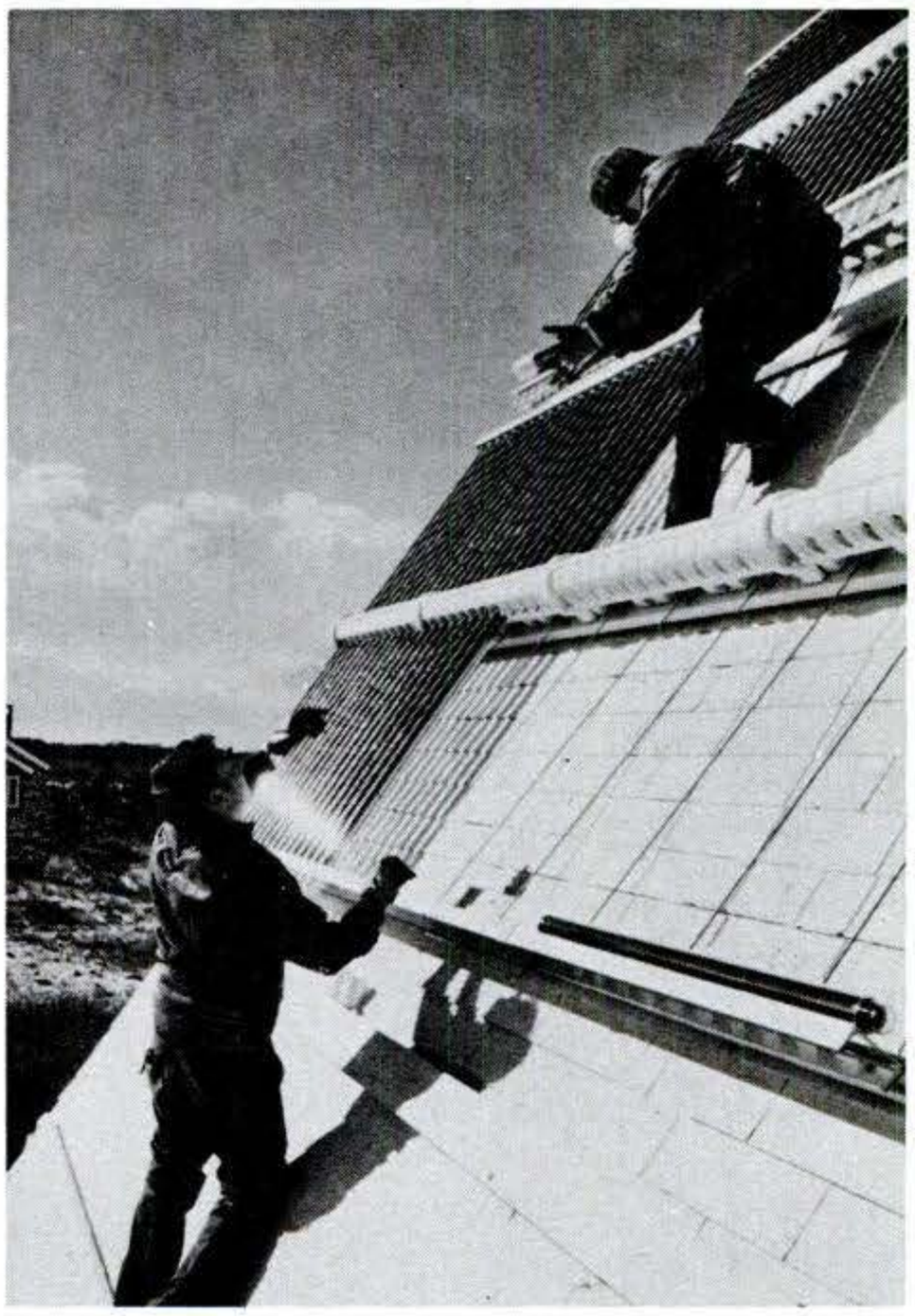

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get parts as age builds up. Manufacturers are discontinuing parts sooner than ever before. I wonder if there's a reason.

Replace dead converters?

When catalytic converters first came on the scene it was said that their life was about three years. After three years, when the converter is no longer doing its job, shouldn't we be permitted to use leaded gas? I don't recall any mandate that makes motorists buy new ones.

Joseph J. Rothengast, West Hurley, N.J.

This is a can of worms. It's my guess that several million dead converters are being dragged up and down the roads. Check two items: Price one (be sure you're sitting down), and try to find a dealer who stocks one.

Brake locks up

I have a problem with my 1980 Chevy Citation right rear brake locking up. I've had new rear brake shoes and drums, a new master cylinder, and a new regulating valve—but there's no improvement. The factory rep says it's perfectly normal for rear brakes to lock on a Citation, but my car pulls around sideways on wet pavement and I'm getting afraid of it.

Albert C. Ballard, Owego, N.Y.

Put 100 lbs. of sand in the trunk. It's a Mickey Mouse fix, but it will help. Have you noticed it's not too bad with a load of people? The problem is that on a hard stop there's too much weight transfer, and there's not much back there to begin with. The rear brakes really need to be cut out almost completely on a driver-only panic stop. The Japanese and German cars have the same weight transfer, but they've got compensators that work pretty well. I don't believe anybody is going to get an engineering award for Chevy's system, but 1982 models are better.

Tale of two transmissions

My two daughters bought new 1978 Olds Cutlasses and have driven and maintained them according to schedule. At 29,000 miles one of the transmissions froze and had to be rebuilt at a cost of almost $600. Then the other one quit at 31,000 miles and had to be rebuilt. One car has a 260-cu.-in. V8; the other, a 305-cu.-in. V8. I've heard of other owners with similar problems.

Al Crist, Riverside, Calif.

Your dilemma is a Pandora's box that I'm sure GM now wishes it hadn't opened. Your transmission's normal service—normal terrain, etc.—seems to do fairly well. But extra load, speed, heat, mountains, and such seem to shorten service dramatically. The only deal is for the manufacturer to build a combination that can do it all—with a little plus. It boils down to buying your car on the manufacturer's reputation. Some are slippery, aren't they?

Vacuum gauge varies

I change the oil on my 1975 Toyota every 2,500 to 3,000 miles and even have the oil analyzed. Now I have 180,000 miles on the car. My question—why does my permanently mounted vacuum gauge give different readings on different days when I idle at a stop sign? Also, I'm trying to eliminate pinging and wonder about water injection with a miniaturized computer control system.

Martin London, Norwood, N.J.

The vacuum reading varies with fuel mixture, barometric pressure, engine speed, temperature, timing, camshaft specs, and valve and ring condition. Water injection sure helps detonation. I prefer metering with a simple control; I reject computers for cars because we can't fix them.

Each month, Smokey Yunick answers questions on cars—family cars, high-performance models, and racing vehicles. Got a problem? Send it to: "Say, Smokey—", POPULAR SCIENCE, 380 Madison Ave., New York, N.Y. 10017. All letters are read, and those of widest interest are answered in this column. Due to the large volume of mail, Smokey cannot reply to letters that are not selected for publication.

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Catalytic ignition
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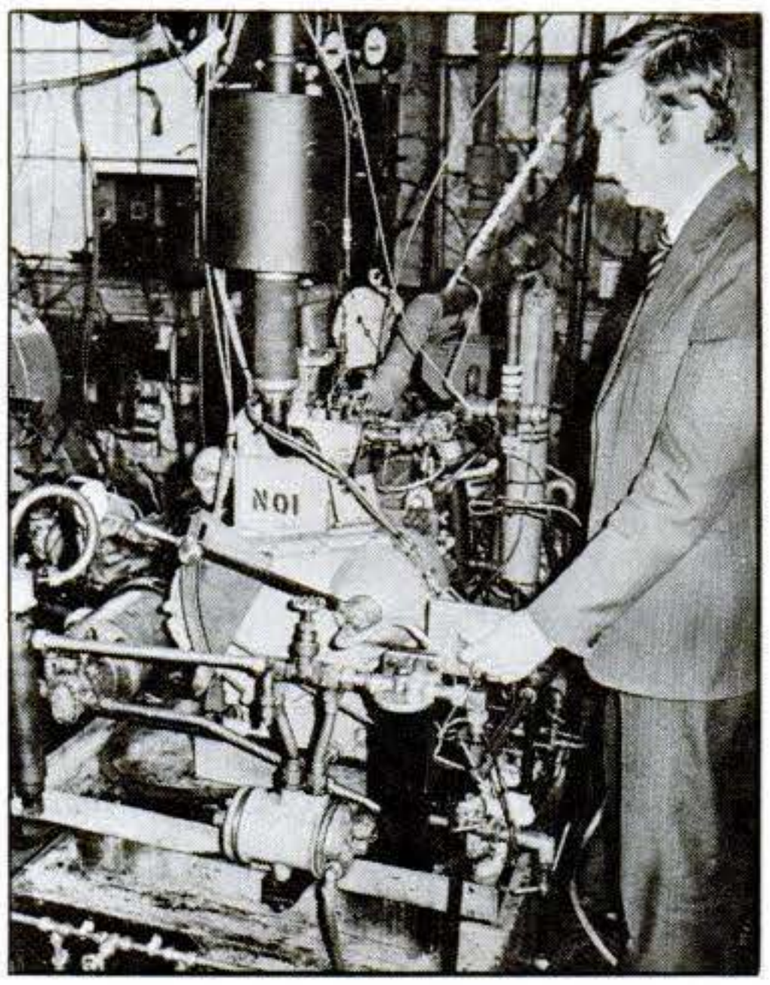

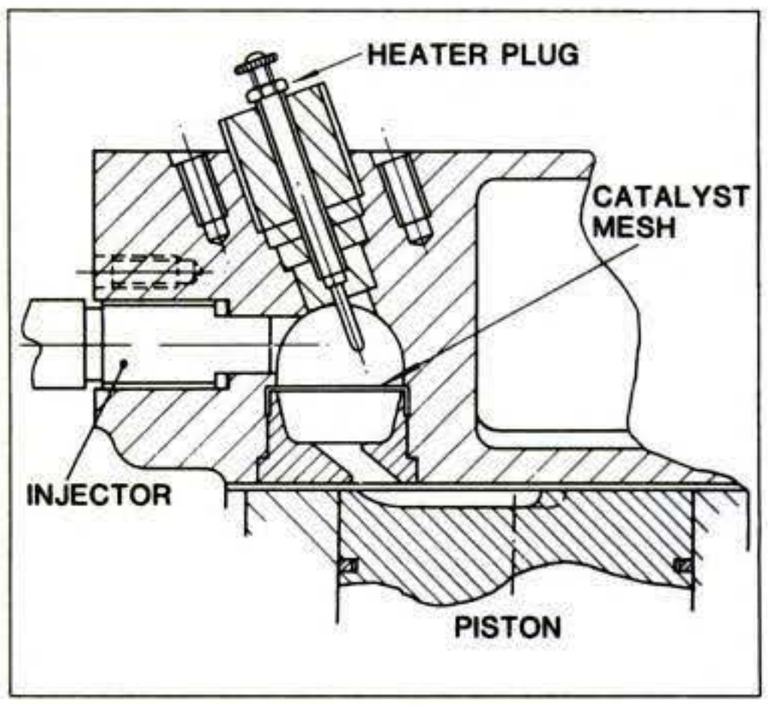

Inside cylinder head, platinum-mesh catalyst sits in a precombustion chamber. Catalyst combines oxygen in air with hydrogen in fuel to ignite the mixture. Heater plug starts the engine by vaporizing first squirt of gas for catalyst.

SHOREHAM, ENGLAND

"This engine resembles a diesel in having a precombustion chamber with indirect injection," Martin C. Overington of Ricardo Consulting Engineers told me. "But it runs on gasoline."

Instead of using a spark plug, the experimental engine before us was using a mesh of platinum-based wire fixed inside the precombustion chamber. The mesh initiated a flame by catalytically combining oxygen from incoming air with hydrogen from fuel.

What started the experiment was a question posed by Johnson Matthey, a British company in the precious-metals business. If a metal catalyst can reduce toxic emissions to safe levels by oxidizing them, it asked, wouldn't ignition by catalyst instead of by spark plug cut pollution at its source? And wouldn't this also allow the use of a high compression ratio for diesel-like economy? They turned to Ricardo for answers.

Overington, project engineer at Ricardo's Shoreham Labs, has some preliminary findings. He was able to raise the compression ratio to 12:1 without knocking, even on low-octane unleaded gas. This ratio gives the best economy on any engine because it optimizes thermal efficiency and power output. But it's too low for a compression-ignition diesel that needs about 20:1 for starting.

A further efficiency gain comes from unthrottled operation, which eliminates pumping losses from a partly opened throttle valve in the air-intake passage. This engine's speed, like a diesel's, is controlled by varying the amount of fuel injected at the start of each power stroke.

In comparative tests, the catalytic engine matched the diesel in fuel consumption and bettered normal gasoline-injection and stratified-charge engines in the mid-load range. On hydrocarbon emissions, the experimental engine beat all the others by a great margin. It had the diesel's low nitrogen oxide level but trailed them all in carbon monoxide emissions except at low and high loads.

There are drawbacks, of course. The catalytic engine needs costly fuel-injection hardware similar to a diesel's. That's because gas is squirted directly into a high-pressure chamber at 2,900 psi, 10 times higher than required by a gas engine with port or manifold injection.

Further, there is the cost and durability of the platinum-wire mesh. Each cylinder requires one of these fragile grids, exposed constantly to intense heat and pressure. In the research engine they last only 20 hours. But that's not a big worry at this early development stage, Overington says. "We figure their life could be greatly extended by different material structures."—*David Scott*

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Condensing furnaces

—can they cut your fuel bill in half?

If there's a vintage fuel-gobbler in your basement, the answer is probably yes

By EVAN POWELL
ILLUSTRATIONS BY GERHARD RICHTER

Last winter, a Cleveland, Ohio, couple replaced their old gas furnace with a new one that was touted to be very efficient. Since both husband and wife worked, there was seldom anyone at home to let in the gas-meter reader. So month after month their gas bills were based on estimates—which were based on their usage the previous year. Curious as to their actual consumption, the man stayed home one day when the gas man was due.

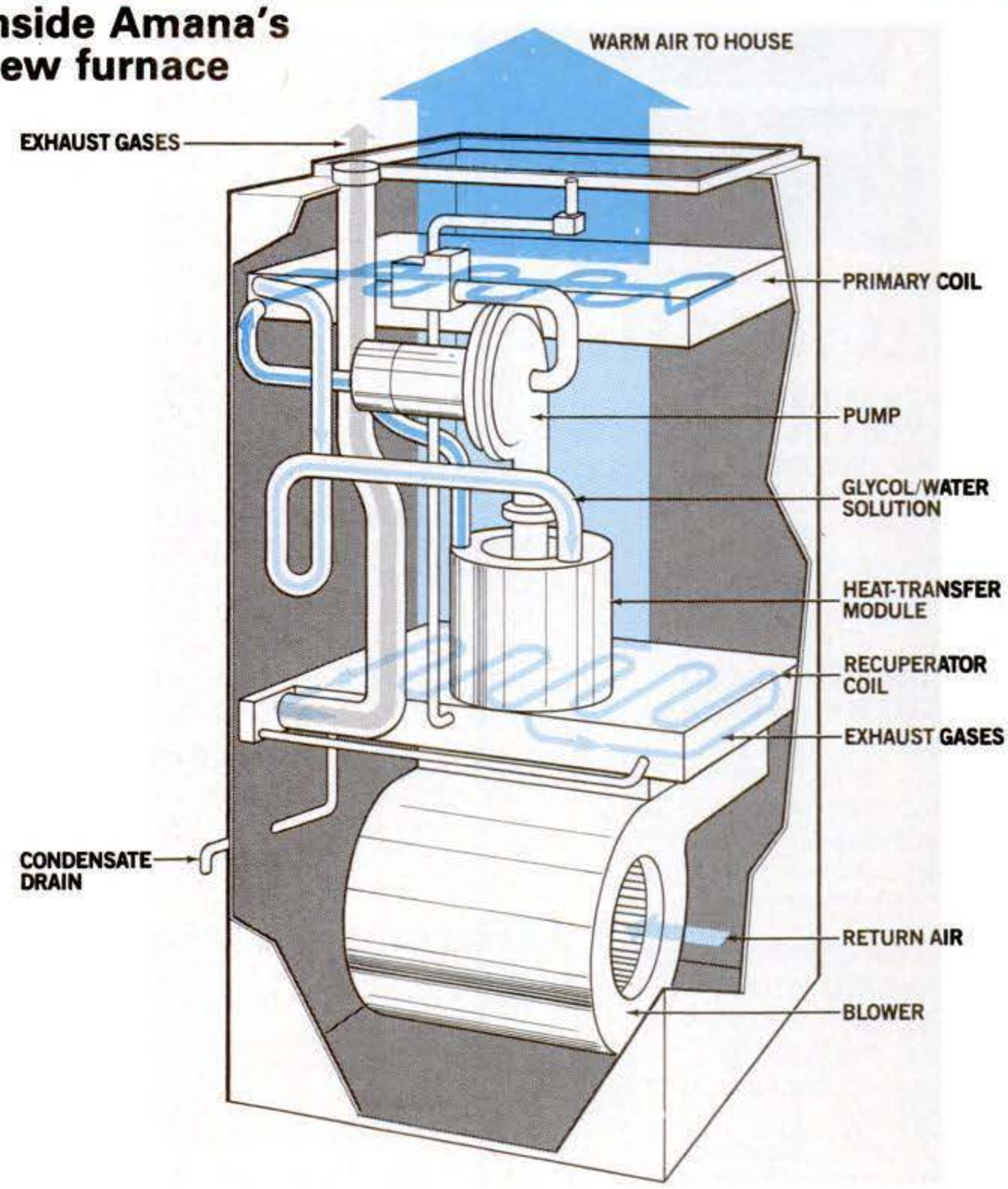
When he actually read the meter, both the gas man and the homeowner were astonished: The couple had overpaid their gas bill by so much that they paid nothing for the next three months.

This happy story comes from Arkla Industries, Inc. (Box 534, Evansville, Ind. 47704), maker of the Arkla Recuperative Heating System [PS, Jan.], the furnace the couple had installed. The Arkla is one of a new generation of condensing furnaces that manages to wring practically the last bit of heat from the fuel it burns. Others in the class include the Energy Command System from Amana (Amana, Iowa 52204), the Ultra Series from Magic Chef (851 W. Third Ave., Columbus, Ohio 43212), and in Canada, the Megasave I from Clare Brothers Ltd. (223 King St., Cambridge, Ont. N3H 4T5).

These are often referred to as recuperative furnaces because they recoup

Continued

Inside Amana's new furnace



The Energy Command furnace uses Amana's innovative—though far from new—Heat Transfer Module (HTM) [PS, Nov. '79]. The eight-by-eight-inch HTM, a steel fin-and-tube heat exchanger surrounding a stainless-steel powered burner with electronic ignition, heats a 50/50 solution of distilled water and glycol as it's pumped through tubes. From there the hot solution is pumped to a copper-tubing/aluminum-fin heating coil where it gives up heat to return air, which is then delivered to the house through ducts.

In a separate cycle, exhaust gases are channeled through a stainless-steel "recuperator" coil, the Heat Trap. Return air flowing over the Heat Trap is preheated before it reaches the primary coil. Vapor in the gases condenses, and condensate flows to a floor drain; remaining gases are forced outside through a PVC pipe. After each heating cycle, a freshwater flush removes acidic residue from the Heat Trap.

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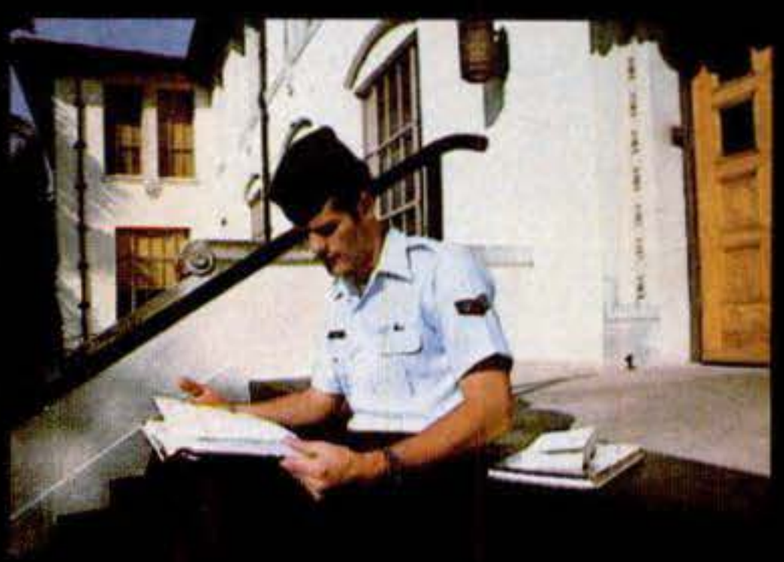

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most of the heat from the flue gases—so much, in fact, that the water vapor in the gases condenses, releasing latent heat. Thus they are also called condensing furnaces. Like the Lennox Pulse furnace [PS, Sept. '82], which is also a condensing furnace, these heating systems don't require a chimney; they can be vented through the wall via a small-diameter pipe. And they are in the same ballpark as the Lennox Pulse in efficiency. But they are quite different in the way they work.

Recouping the losses

Except for the Energy Command, which uses Amana's unique Heat Transfer Module for combustion and a glycol solution as a heat-transfer medium (see diagram and explanation, opening page), the combustion systems of these recuperative furnaces are not much different from that of an ordinary gas furnace—up to a point.

When the thermostat calls for heat, the gas valve opens and the burner is ignited by electronic spark ignition, as in any modern gas furnace. The heated combustion gases go up through the inside of a heat exchanger, around which the air from the house circulates, extracting heat. The combustion gases leave the heat exchanger at about 400 to 550 degrees F. At this point, an ordinary furnace sends the gases up the chimney, literally heating all outdoors.

Not so with the recuperative furnaces. They all extract much more of the heat. The Magic Chef uses a powered burner to deliver just the right amount of air for combustion and a heat exchanger with increased surface area to extract more heat from the flue gases. The heat exchanger is made of stainless steel so that it won't corrode in the presence of the somewhat acidic condensate that forms when the flue gases cool to below the dew point. The Arkla furnace uses a fan-powered vent to force the flue gases through a stainless-steel secondary heat exchanger after they leave the primary coil (see diagram). Condensation occurs in the secondary chamber. The Clare furnace has a three-stage heat-exchanger system, with the third one made of stainless steel to handle the condensate. In all, the condensate flows from a drain on the furnace to a floor drain or condensate pump.

These furnaces deliver additional efficiency because they minimize off-cycle losses. In a conventional furnace without a vent damper, warm air from the house is pulled through the burner and up the chimney, even when the burner is off. Since these furnaces use no chimney, this doesn't happen (and no vent damper is needed).

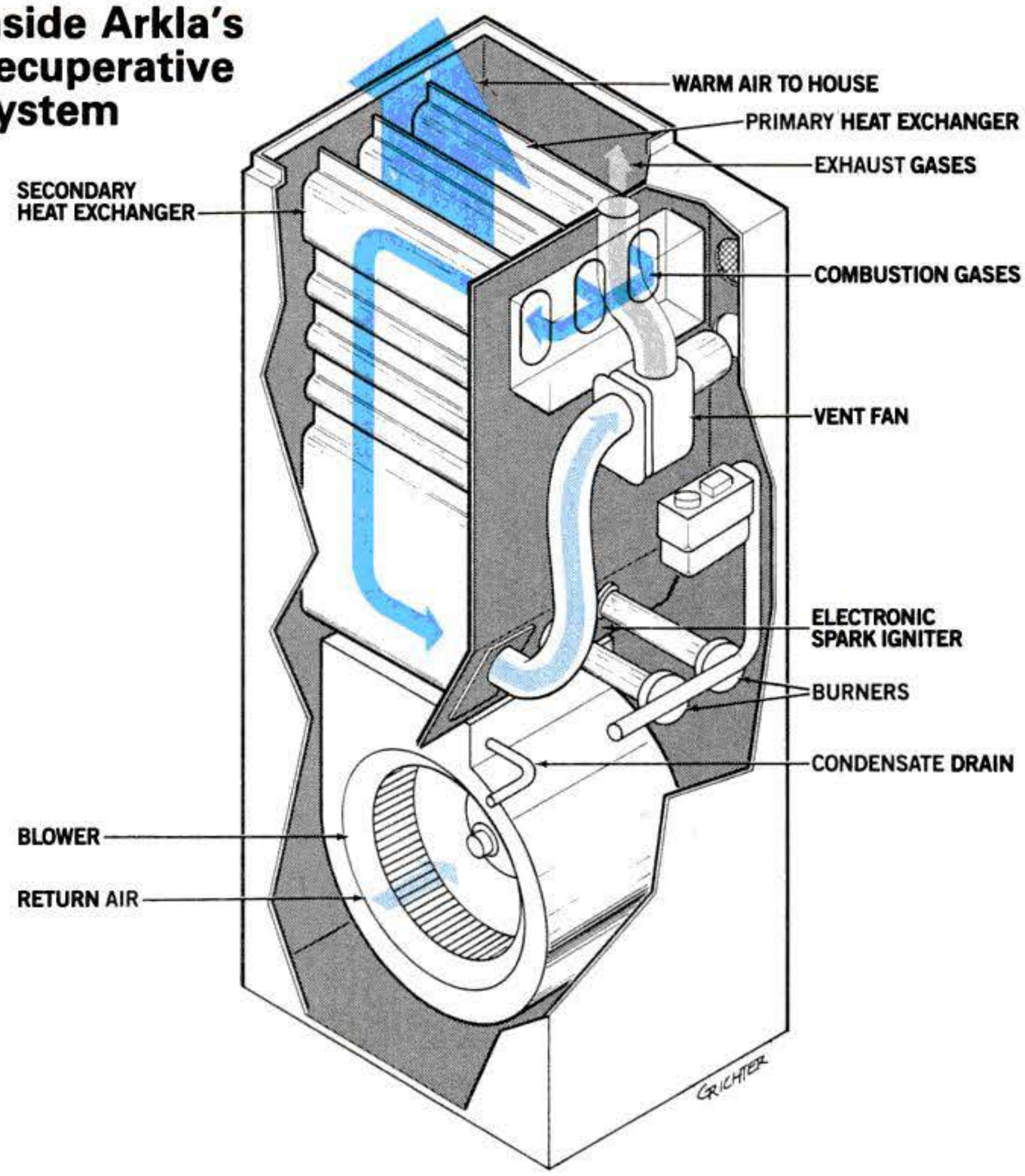
Amana's Energy Command furnace can heat your domestic water as well as your house, if you attach an optional water heater. A diverter valve routes the glycol solution that has been heated by the furnace's combustion system to a copper heat exchanger in a 40-gallon, foam-insulated tank. "The system delivers 2½ to three times more hot water than a conventional 40-gallon water heater," claims an Amana spokesman. "That's because the heat input is much greater—up to 100,000 Btu/hour, compared with 40,000 to 50,000 in a conventional heater. The result is that the 40-gallon tank can deliver up to 126 gallons of hot water per hour."

The Annual Fuel Utilization Efficiency (AFUE) ratings, determined according to U.S. Dept. of Energy standards, are impressive for all these new furnaces. The Energy Command tops the list at 94.5 to 95 percent efficiency, depending on Btu rating—about a tie with the Lennox Pulse furnace's 96 percent. The Arkla ranges from 85.5 to 87.1, and the Magic Chef from 86 to 87.3. The Clare Megasave's annual efficiency, tested according to Canadian standards, is 93 percent. Compare those numbers with the 50 to 60 percent efficiency of many existing furnaces, and it's easy to see that some homeowners could, indeed, cut their heating bills almost in half.

In new construction, a recuperative furnace could even be the least expen-

Continued

Inside Arkla's Recuperative System



The Arkla uses a secondary heat exchanger to recoup heat that's normally wasted. When the thermostat calls for heat, the gas valve opens and gas is ignited. Combustion gases flow up through the primary heat exchanger, which warms the air that the blower circulates over the heated surfaces. The warm air is then distributed to the house. Meanwhile, a vent fan forces the gases down through the stainless-steel secondary heat exchanger. Here water vapor condenses, latent heat is captured. Condensate is drained out, and remaining gases—at 150 to 225 deg. F—are exhausted.

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Condensing furnaces

[*Continued*]

sive kind to install: Eliminating a chimney could more than offset the premium price of the equipment. And since it doesn't have to be tethered to a chimney, you can install one almost anywhere.

Installed costs vary greatly, since every installation is a custom job. Magic Chef and Arkla give estimates ranging from $1,100 to $1,500, not including new ductwork. Amana's Energy Command would come in at a hefty $2,500 to $3,500 installed, the company reports. (Companies normally quote installed costs only, since that's how most furnaces are sold.)

Recuperative furnaces are sized to replace existing furnaces with a minimum of alteration. But for a retrofit, the high initial cost of these models may not be recovered for years if you've already reduced your home's fuel consumption to a low level.

However, if your situation is like that of a New Jersey couple I spoke with recently, a retrofit could be a bargain. They spent $3,600 on heating fuel last winter. At that rate, a premium-priced recuperative furnace would pay off fast. PS

Condensing boiler from Weil-McLain

The first condensing boiler, like the first condensing furnace, used pulse-combustion technology. That was the gas-fired Hydropulse [PS, Nov. '79], introduced by Hydrotherm (Rockland Ave., Northvale, N.J. 07647) in 1979. (A boiler uses hot water or steam to heat the house; a furnace uses forced air.) The new gas-fired VHE (for very high efficiency) boiler from Weil-McLain (Blaine St., Michigan City, Ind. 46360) uses a more conventional induced-draft combustion system. To capture more of the heat from the fuel it burns, the VHE boiler incorporates a special heat exchanger called the Heat Extractor. It receives the flue gases after they've passed through the boiler section and transfers much of the remaining heat in the gases to the cool, circulating water, which is channeled through the Heat Extractor as it returns from the radiators in the house. The flue gases cool to below the dew point (about 200 deg. F) in the Heat Extractor, losing latent heat. The condensate is drained off through a floor drain and a fan forces the remaining flue gases out through a small vent pipe. At the same time, the water, which was preheated in the Heat Extractor, continues to the boiler section for further heating. From there it is pumped back to the radiators, and the cycle repeats. To reduce off-cycle losses, a flexible flap in the flue automatically closes when the fan is off.—*V. E. Smay*

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For 1983, Chrysler increases its warranty protection to two years.

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*For 1983, all domestic outboards, purchased from authorized U.S. Chrysler Marine dealers, will carry a 2-year limited warranty against defects in materials and workmanship on the entire product. Both parts and labor.**

America's longest warranty. America's lowest dealer prices. *It's not surprising that Chrysler Marine leads the industry in warranty protection. Chrysler is a leader in bringing design simplicity/easy maintenance to outboard engines. And model for model, Chrysler offers its dealers the lowest wholesale prices of any major manufacturer. So, our dealers can pass along important outboard savings to you.*

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LOOK AND LISTEN

By WILLIAM J. HAWKINS

Speed and quality

It's our turn, audio fans. Sure, for the past couple of years the videophiles have been enjoying the attention of the technical talents of most companies. But now that engineering ingenuity is showing up in audio gear. Example: this AD-WX110 dual-cassette recorder from Aiwa.

I knew it was different even before lifting it from the shipping carton: It's small, just 4¼ by 11½ by 13 inches. But don't let its size fool you—it's got more packed into it than any *two* decks I've ever seen.

The deck has two cassette transports—one for playback only, another for recording or playback. Pop a prerecorded tape in one side, a blank tape in the other, and press a dubbing button. Soon you'll have an exact copy of the original tape. But wait. I know dual-cassette recorders have had that capability for some time. With this deck, simple dubbing is just the beginning.

Press another button, marked TRACK, and the deck copies both sides of the tape at the same time. That cuts recording time in half. Now press another button, called SPEED. With this, the speed of both tapes is doubled. Result: You get a copy of an original tape in one-fourth the usual playing time. A 60-minute tape, for instance, is done in 15. (And there is no indication from the manufacturer that this high-speed dub lessens sound quality.)

Special effects? A few. A built-in mike-mixer control allows you to mix your voice with the original tape (for introducing a song or—gulp—singing along). The copy tape will capture it all.

There is also a RECORD MUTE button that serves a couple of purposes. Press it while dubbing one tape to another, and the sounds from the original tape are replaced by a blank passage on the copy. This allows you to edit out commercials, for example, or add silent spots between record cuts (for in-concert recordings that have applause between cuts, for instance). Once the dead spots are placed on the copy tape, they can be used later for one of the deck's other tricks: automatic cueing.

Press the PLAY and FAST FORWARD buttons at the same time, and the deck automatically advances the tape to the next silent spot on the tape—the next song—and begins to play it. This automatic cueing can be done in fast forward or reverse and is a real timesaver for locating a particular area of tape. You can also search manually by fast-forwarding or reversing the tape while in the play mode. When you do, you'll hear the passages whizzing by.

While all this clever gadgetry is fine, there is more to performance than a pretty faceplate. Controls, for instance, are solenoid actuated. That allows the deck to make unattended recordings by merely adding a timer. And the unit can be set for continuous play: When the tape runs out on one side, the deck automatically starts playing the cassette on the other side.

There are no controls to set the deck for specific types of recording tape—that's done automatically when you drop the tape into position. LEDs, mounted within the two tape-compartment doors, indicate the type of tape presently in use (it accepts metal tape) and the bias. A manual control also allows you to fine-tune record bias for a specific tape.

Dolby? Of course, but this deck lets you choose either the standard Dolby B or the newer Dolby C system for a 73-dB signal-to-noise ratio. Other specs: Frequency response is 20 Hz–18 kHz with metal tape; 20 Hz–17 kHz with CrO_2; and 20 Hz–16 kHz with standard. Wow and flutter is 0.05 percent (WRMS). Price: $430.

Quick looks

- Now it appears that the VHD disc player will never make it to store shelves. JVC, Matsushita, Thorn, and GE, partners in the venture, have suspended videodisc and player production for the U.S. (JVC may still introduce it in Japan.) That leaves RCA's SelectaVision and Pioneer/Philips' Laservision as the only two contenders for the present and future videodisc market.
- Is it illegal to snag HBO microwave signals with a home rooftop antenna? It apparently is in Minnesota. A U.S. District Court in St. Paul has found one TV bandit guilty of violating the anti-piracy section of the Communications Act. And cable officials in Minneapolis are now using patrol trucks armed with electronic surveillance gear to locate home receivers. But all this could become academic in the near future. Zenith, for example, is presently designing a reasonably priced scrambler for microwave transmissions.
- Pioneer has gone digital: Its Digital Direct Decoder circuit eliminates the need for conventional filters in a tuner. It improves separation, signal-to-noise ratio, and adjacent-channel interference. A second digital circuit is being used in what may be the next generation of PCM (pulse-code modulation) tape recorders. Audio signals are recorded as a 14-bit digital "word" on eight tape tracks. Result: a frequency response of 2 Hz to 20 kHz, signal-to-noise ratio of 85 dB, and no distortion. And, unlike other PCM systems that require special tape, this model 2814 uses standard videotape in a conventional audio-cassette shell. Sorry, folks, but both the tuner and recorder circuits are still in the experimental stage.
- Goodbye CB radio? GE is presently waiting for FCC approval on a new low-cost, private, mobile-communications system. It will use the 900 MHz band.
- And finally, AT&T has announced a system that doubles the number of TV transmissions present satellites can carry—with no loss in picture quality. (It could be trebled, according to a spokesman, with somewhat lower picture quality.) If it works, the technique could have a dramatic effect on the use of present—and future—satellites. PS

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Popular Science

PS | What's News

Two years ago I decided that rapid advances in personal-computer hardware were over. In preceding years we had seen an incredible series of developments. Computer kits (often with only the sketchiest instructions) were in the mainstream a half-dozen years ago. Typical units had four kilobytes of random-access memory. The standard storage unit was the cassette tape recorder.

By 1981 the picture was vastly different. The *de facto* standard RAM was 64K, disc drives were universal for all but the most elementary machines, and kits (with the notable exception of those produced by Heath) had all but disappeared. Now, we told ourselves, we have this splendid, more-or-less standard machine based on the eight-bit microprocessor. It has all the memory and disc storage space needed to do anything a home user could think of—indeed, enough to run all the programs necessary to handle a pretty good-sized business. The technology, I said, is mature. From now on, the important developments will be in software.

I couldn't have been more wrong. Looking back now, the last two years can be seen as a time of intense hardware development. The Winchester hard disc, with its huge storage capacity [PS, Oct. '82], is here, and price is dropping rapidly. Within a few years I expect it to be standard on all but extreme low-end machines. The 16-bit processor has come along with its capability of addressing a *million* or more bytes of random-access memory. This has opened up the possibility of far more complex—and thus more user-friendly—software. So now a number of new 16-bit machines are coming along, and *that* technology promises to establish itself as the standard in the near future. Prices have continued to plummet, so extremely powerful machines can now be afforded by individuals. At the same time, the low end of the line has exploded. Timex Sinclair, Commodore, Texas Instruments, Atari, and others have marketed machines for $100, $200, or $300 that have enough capacity to do serious computer jobs. Some even have color capability! The progress has been astonishing.

Now the latest. A couple of years ago Adam Osborne brought out his portable machine. He has sold thousands of them. Now, a whole batch of machines based on the Osborne concept has hit the market. They are not to be confused with the limited-capacity hand-held computers [PS, Aug. '82]. The new portables are full-capability machines. They have built-in disc drives and, usually, 64K of RAM. A couple are 16-bit machines and can run either CP/M programs designed for eight-bit machines or the new 16-bit programs just beginning to surge onto the market. They are the operational equal of the non-portable high-capacity desk-top mainstream computers. But they are wrapped in extremely small packages.

I was not really aware of just what a forward jump they represented until we got some in the office to evaluate. Now, having used some of them, I can tell you that they are really little jewels. The screens, though small, have extremely good resolution. The keyboards are of excellent quality; in some cases they are the same keyboards used on large units. The prices are terrific. As the article in this issue points out, they are outstanding bargains because the price not only includes the machine but a lot of software, as well.

Once we had seen the machines, we realized that they represent a new direction in the computer industry, and that they are the first entries in an important new class of products. We thought the development significant enough to feature on our cover. That cover photo, incidentally, was a joint effort of Art Director Dave Houser and Staff Photographer Greg Sharko. The article is by Gordon Mc Comb, who has done several recent computer-related pieces for POPULAR SCIENCE.

Soaking up sunlight

Remember solar ponds? They're constructed to have layers of water of different salinity. At the top the water is fresh; at the bottom it's several times saltier than seawater. Sunlight warms the water. Normally, the heated water rises and forms a layer near the top, while cooler water falls to the bottom. In a solar pond, though, the greater density of the salty water on the bottom prevents this normal convection. The water on the bottom can get hot—often close to boiling.

Now the country's largest solar pond has gone into operation near Chattanooga, Tenn. It covers an acre, is 10 feet deep, and contains 2,000 tons of dissolved salt. The TVA-built facility should collect about 150 kW of thermal energy continuously.

The energy gathered should cost about $11 per million Btu, compared with $1.80 for coal. A 10-acre pond would cut the cost to $5–$7. Even the one-acre pond could heat homes in the neighborhood for about the price of fuel oil. And, of course, a pond is both a collector and storage unit, delivering its stored energy on cold, rainy nights as efficiently as it does when the sun is shining.

Updates

- Despite the concern by some researchers that optical fibers [PS, May '80] are not yet rugged enough to operate in a rigorous undersea environment, several companies are now prepared to lay an optical cable across the Atlantic. They'll take the several hundred million-dollar risk because of the potential benefits. The cable should be able to handle 36,000 telephone calls simultaneously—four times the capacity of today's copper cables. And that should make prices competitive with satellite transmissions.
- A new class of products, based not on electric motors but on the piezoelectric effect [PS, July '82], has come on the market. Piezo Electric Products has begun turning out its first product: an electric fan that creates a breeze by beating its wings like a big bird.
- That huge movable dam designed to protect London [PS, Nov. '80] has swung shut for the first time. The 1,700-foot line of steel gates and concrete piers—the world's longest movable flood barrier—now stands ready to block winter tidal surges that have flooded London.
- The Cyclo-Crane, a large hybrid helicopter-blimp [PS, Nov. '81], was finally floating above its mooring in Tillamook, Ore., ready for tests to determine whether it can economically move heavy loads (such as lumber from forests in remote sites). It had taken 10 years to design and finance. But the 136-ft.-long ship escaped its mooring and crashed in a nearby field, and was destroyed. The company says it will try to finance a new version.

Editor-in-Chief

New powerful portables

–best buy in a personal computer?

Big computer power in a small, totable package: This Otrona Attache, for example, is no larger than a portable typewriter.

Small and low-priced, they can do everything the big boys can—almost

By GORDON MC COMB
PHOTOS BY GREG SHARKO

It looks like a suitcase—an unassuming rectangular box with a handle on top. Look again. Pop its cleverly designed latches and fold down the detachable front cover, and you're seated in front of a complete desk-top computer.

The newest computers are pack-'em-up, pick-'em-up portables that go with you. No, these are not the hand-held "calculator" types. (I'll cover those in a future issue.) These "suit-case-style" models are full-featured units—complete with CRT, disc drives, and standard keyboard—squeezed down to a portable size and weight. Carry one between your home and office, take one on your next business trip, or, using a battery-pack option, even compute while you commute.

But there's more to these units than just portability. Their small size, built-in convenience, and relatively low price tag (they start at $1,800, including software) make them an excellent choice for permanent installations at home or in the office. You

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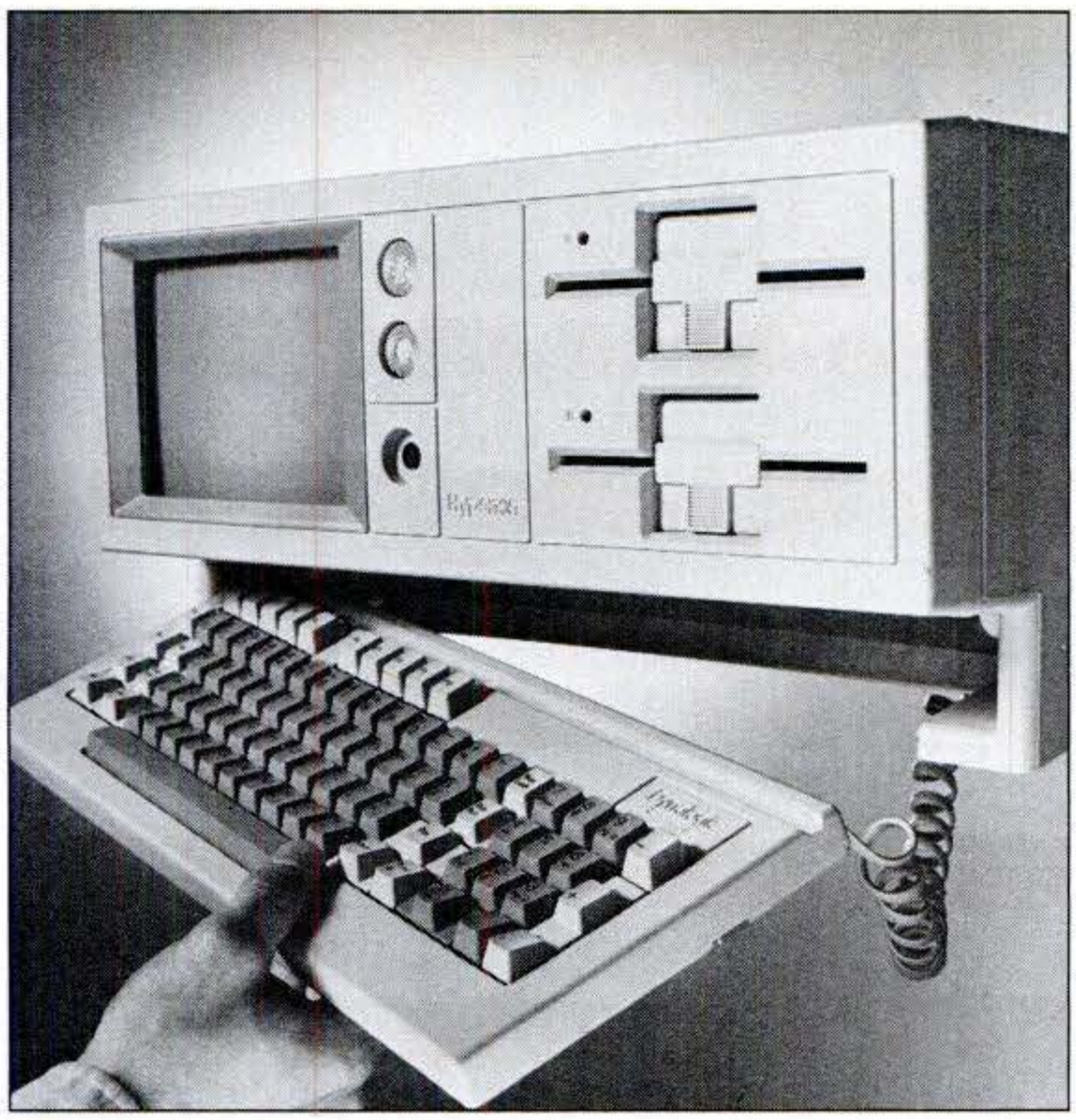

Slip the keyboard under the Dynalogic Hyperion model and you're ready to go. System is compatible with IBM programs.

The two micro-disc drives in the Jonos Escort accept the new 3½-inch discs. Each holds up to 322,000 pieces of data.

need not devote half a room to your computer gear—just half a desk top. Or you can use one as you do a portable typewriter: When you're through, pack it up and stow it out of sight.

All of this is good news, but what about the bad? What do you give up for portable power? How do these models stack up against conventional desk-top computers at the same price? And how do the new machines compare with each other? Here's what I learned.

What you get

Normally, buying a computer is much like buying a car. You're quoted the basic price; then you find out about the options you'll also need. But the portable computers, in general, come complete with all the essentials. Take a look at what you get:

- A computer with a full-function, full-sized keyboard. That's extremely important for text entry and word processing. The Kaypro and the Chameleon, for example, use the same keyboard as in DEC's $1,800 VT-100 computer terminal. The other portables use keyboards of similar high quality. Most also have a separate 10-key numeric key pad for fast and accurate number entry. The keyboards are detachable from the computer for greater ease of use.
- At least one standard input/output connector (I/O port) to add external gear—modems, printers, plotters—without the need to buy special cables or expensive plug-in circuit boards (electronic interface cards). There are two types of standard port connections: serial and parallel. Several computers, such as the Kaypro, Mayflower, and the M6000P, offer *both* for even more flexibility. (The Mayflower, in fact, has two of each.)
- A disc drive or two—each capable of storing between 102 kilobytes (102,000 characters) and one million bytes. The larger the storage capacity, the easier it is to use the computer and the more complex the programs can be. Two units, the Courier and the Dot, use the newer micro-disc drives that can store an incredible 280 to 320K on a pocket-sized, 3½-inch disc. The other portables come with standard 5¼-inch disc drives; many are compatible with discs used in other machines, such as the IBM PC and Xerox 820.
- A five- to nine-inch CRT (measured diagonally), in white-, green-, or amber-on-black colors, capable of displaying up to 25 lines of 80 characters each. All but two of the computers allow you to add external monitors, although several, such as the Osborne and the Courier, require you to add special $40 to $100 adapters.
- A minimum of 64K internal RAM memory—enough to store about 40 double-spaced typewritten pages. That's more than enough for nearly every business or personal software package available today. What about tomorrow? Several of the machines, such as the Hyperion and Dot, can be expanded to 256K for even greater power.
- Finally, some units come with their own built-in printer and telephone modem to communicate with other computers over a phone line.
- And to entice you even further, many include their own bundle of $1,000+ worth of business-oriented application software. The Kaypro, for instance, comes with word-processing, electronic spread-sheet, filing, and spelling-checker programs—combined, worth $1,200. The price for both computer and software? Only $1,795.

All this means you can use a suitcase unit to write letters, prepare income taxes, do household filing, talk to other computers, program, calculate budgets . . . all the things you can do with the average desk-top computer—and often for less money.

Sounds like portable computers are too good to be true, right? Well, almost. You do give up some features normally found on desk-top computers. Check these pros and cons.

A close look

The largest screen on any portable is nine inches, which produces characters about 30 percent smaller than the 12-inch screens used in most desktops.

Some machines, like the Osborne and Mayflower, have a five-inch screen—a 60 percent size reduction. Those small sizes could give some people trouble. To alleviate this problem, many portables allow you to attach larger external monitors. But, of course, that destroys the portability of the computer and adds to its price.

The four IBM-compatible machines (see table), although technically ca-

Continued

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Popular Science buyer's guide to portable computers

Manufacturer	Model	List price ($)	Standard memory	Weight (lbs.)	Screen size (in.)	Type screen	Screen format	Microprocessor	Language(s), operating system	With business software	No. of disc drives	Disc type	Disc-drive capacity (each)	
Compaq	Compaq	2,995	128K	28	9	Gr	80×25	8088	MS-DOS		1	5¼", SS DD	320K	
Computer Devices	Dot	3,495	64K	27	5×9	Gr	80×25	8088	BASIC; MS-DOS		1	3½", SS DD	288K	
Computer Systems	PC/8088	3,995	64K	30	9	Gr	80×25	8088	MS-DOS		2	5¼", SS DD	320K	
Dynalogic	Hyperion	4,995	256K	20	7	Amb	80×25	8088	BASIC; Pascal; Fortran; MS-DOS	●	2	5¼", SS DD	320K	
High Technologies	Mayflower II	3,350	64K	30	5	Gr	80×25	Z-80	CBASIC; CP/M		1	5¼", DD DD	1M	
Jonos	Escort C2110	3,995	64K	25	9	Gr	80×25	Z-80A	BASIC-80; CP/M	●	2	3½", SS DD	322K	
Kaypro	II	1,795	64K	26	9	Gr	80×24	Z-80	SBASIC; CP/M	●	2	5¼", SS DD	192K	
Micro-Source	M6000P	3,900	64K	34	9	Gr	80×24	Z-80A	BASIC; CP/M	●	2	5¼", DS DD	386K	
Osborne	01	1,795	64K	23.5	5	B/W	52×24	Z-80	MBASIC; CP/M	●	2	5¼", SS SD	102K	
Otrona	Attache	3,995	64K	18	5.5	B/W	80×24	Z-80	BASIC-80; CP/M	●	2	5¼", DS DD	360K	
Seequa	Chameleon	1,995	128K	28	9	Gr	80×25	Z-80, 8088	BASIC; CP/M; MS-DOS	●	2	5¼", SS DD	320K	
Telcon	Zorba	1,595	64K	22	7	Gr	80×25	Z-80A	BASIC; CP/M		2	5¼", DS DD	380K	
	Nomis	2,395	64K	22	9	Gr	80×25	Z-80A	BASIC; CP/M		2	5¼", DS DD	380K	

pable of a color display, have black-and-white monitors. If you need color, all but the Hyperion allow you to add an external color monitor. But plan to spend an extra $300 to $400 for this option.

The good part (besides price) of getting software with the machine is that it is already customized for the computer. WordStar, for example, is the most popular word-processing program but has a rather complex installation routine. But if you get it with an Osborne, for instance, WordStar is already set up for the computer. Just put the diskette in the drive and you're off. Great, but there is one drawback to this.

When you buy a portable that comes with software, you're stuck with the programs—whether you want them or not. If one or more of the programs just won't do, you'll need to buy replacements separately. And no, you can't exchange the programs that come with the portable for others.

Few portables are now available with an integral printer (one designed specifically for that machine). Even fewer come with one built in (see table for more details). If your portable is to be used as a permanent fixture in your home or office, the solution is simple: Buy nearly any printer and plug it into the computer with the proper cable. If you're going to be toting the portable around and need printing capability, however, you'll find a built-in or integrally attachable printer a blessing. This limits your choices considerably.

Either one of two types of microprocessors is used in today's suitcase portables: the Z-80 or 8088. Both are standard within the industry.

Those machines using the eight-bit Z-80 (or its faster cousin, the Z-80A) operate under the CP/M operating system. That means, in theory, that some 2,000 off-the-shelf business programs can be used with your new portable. But you can't buy just any CP/M program and expect it to work with your portable.

The reason is compatibility. There is no disc standard in the microcomputer industry. Osborne discs can't be used with Kaypro, for example. When you buy a CP/M program, you must indicate which computer it's to be used on. What if the program you want isn't available for your format? Simple—you wait until it is.

There are some happy exceptions, however. Don't fret that you don't see many programs that say "fits the Kaypro II." Reason: The Kaypro uses diskettes designed for the Xerox 820 personal computer. The Zorba, Nomis, and Mayflower can read and write on Xerox 820 discs, too. They can also use Osborne and Heath (89/90 models) discs. This emulation capability makes these portables particularly flexible.

Computers with the 16-bit 8088 processor are IBM compatible. They run programs under MS-DOS, the operating system used by the IBM. Since the 8088 is a 16-bit chip, it can use more random access memory; so it isn't unusual to see IBM-compatible portables available with 128K or more of internal RAM memory.

Although IBM-compatible machines can read and write IBM-format diskettes, exceptions will occur. If the program calls out to a certain "address" specific to the IBM personal computer—an address the portable doesn't share—you'll only see a blank screen. But here's where the portability really comes in handy: Take the computer to the store with you and test the software before you buy.

One computer, the Chameleon, has both a Z-80 and an 8088 microprocessor. It can handle both MS-DOS and CP/M programs. In addition, at least one computer manufacturer, Computer Devices, offers a program-transfer service. You buy a program on just about any type of disc and send it to the company, and it will transfer the program to the format used by the Dot portable.

You may not always use your computer as a portable. In fact, you may

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Disc drive emulates	External display	RS-232C port	Parallel port	IEEE-488 port	Other port	Expandable w/opt. internal cards	Integral printer (opt.)	Battery pack (opt.)	Numeric key pad	Function keys	Case	Type of software	Typical full-system cost ($)	Modem	Comments
IBM PC	●		●			●			●	●	P	None	4,460	Opt.	Expandable to two drives, other IBM peripherals, hard disc
	●	●				●	●		●	●	P	B	4,885	Opt.	Printer $599
IBM PC		●	●			●		●	●	●	P	None	5,460	Opt.	Computer available in various versions
IBM PC		●	●						●	●	P	WP, SS, B, C	5,860	Inc.	Built-in modem with carrying case
Xerox 820	●	●	●				●		●	●	P	B	4,065	Inc.	Built-in printer, modem, separate case
	●	●				●	●	●	●	●	M	WP, SP, SS, B	4,960	Opt.	Integral-printer option; 128K expandable
Xerox 820		●	●						●	●	M	WP, DBM, SP, SS, B	2,760		Good software selection
	●	●	●			●	●	●	●	●	M	WP, SS, B	4,865	Opt.	Best in industrial applications with printer option
	●	●		●				●	●		P	WP, SS, B	2,760	Opt.	First portable integral modem available
	●	●			●	●		●			P	WP, B, graphics	5,160		Color-filter selector for CRT screen; lightest portable
IBM PC	●	●	●			●			●	●	P	WP, SS, B	2,960	Opt.	Dual processor
IBM, Osborne, Xerox 820, Heath	●	●	●						●	●	M	Opt. $180 software package inc. WP, DBM, SP, SS, B	2,560	Opt.	Shock-mount version $400 extra; integral modem available
IBM, Osborne, Xerox 820, Heath	●	●	●						●	●	M	Same as above	3,360	Opt.	Expandable to hard disc, 16-bit processor

TABLE KEY

Type screen: B/W = black & white; Gr = green; Amb = amber.
Screen format: character format, columns by rows.
Disc type: size, in inches of diskettes used; data density, i.e., SS SD = single sided single density; SS DD = single sided double density; DS DD = double sided double density.
Case: M = metal; P = plastic.
Type of software: Software included in base price of machine or as part of option package (price as indicated); WP = word processing; DBM = data-base management; SS = spread sheet; B = BASIC; C = communications; SP = spelling checker.
Typical full-system cost: Average cost for computer with $500 dot-matrix printer, modem, interconnect cables, word processing, spread sheet, BASIC, communications software, and battery pack. Prices for software added if programs not included in base price; all items calculated even if item is not available for computer.
Modem: Opt. = optional; Inc. = included.

never move it from your desk. But if and when you do, there are some important facts you should know.

Portable computers are a bit heavy; most are about 25 pounds. That's not much, you say? Try porting one from one end of an airport terminal to the other. Suggestion: If you must carry the computer around a great deal, invest in a fold-up luggage stroller ($15 to $25).

Contrary to what portable-computer ads suggest, you can't use one just anywhere: You can't use it on airplanes. For one, it won't fit on the fold-down table in front of you. The average machine requires a depth of about 22 inches when in use. And second, the pilot wouldn't let you use it even if you could balance it on the table. Suitcase portables emit radio-frequency "hash" that can, given the right circumstances, interfere with the instrumentation aboard the aircraft. You can, however, stash the computer under the seat.

Portable computers have either a molded-plastic case, such as the Osborne's and Attache's, or a metal case, like the Kaypro's and M6000P's. Which is more durable? Neither, when it comes to computers: No portable, no matter how well built, will withstand abuse. Never check a suitcase portable as luggage—carry it on the plane, bus, or train yourself.

The disc drive should be protected as much as possible. At this writing, only the Attache uses rubber shock mounts for the disc drives. The mounting protects the drives while the computer is being transported and lessens the chance of something popping out of adjustment. The Zorba and Nomis computers are available in a shock-mount version protecting the entire computer against vibration.

Most interestingly, I found that not all suitcase portables are available with a DC-power option. Those that have the option require external batteries; none have them housed inside the machine. The battery is good for one or two hours of use before it requires recharging. Only Attache has a larger, 10-hour-battery option.

How do you choose the right portable for your needs? Follow one simple rule: Know how mobile—if at all—you must be.

If you need to cart the machine only occasionally and can leave the printer and telephone modem behind, a fully integrated compact system is an unnecessary expense. You may do better by mixing components—a portable with desk-top peripherals—to come up with a usable system.

If you're constantly on the go but need a modem or printer only occasionally, then a system with integral components may be the most economical choice. But if you need portability and peripherals at all times, look at the all-in-one models.

Whichever way you choose, any one of the new portable personals will give you exceptional power and performance in a single, low-cost, versatile package. PS

MANUFACTURERS' ADDRESSES

Compaq Computer Corp., 12330 Perry Rd., Houston TX 77070; **Computer Devices**, 25 North Ave., Burlington MA 01803; **Computer Systems**, 26401 Harper Ave., St. Clair Shores MI 48081; **Dynalogic Info-Tech Corp.**, 141 Bentley Ave., Ottawa, Ont. K2E 6T7; **High Technology, Inc.**, Box 953, Sandy UT 84091; **Jonos Ltd.**, 920-C E. Orangethorpe, Anaheim CA 92801; **Kaypro (Non-Linear Systems)**, 533 Stevens Ave., Solana Beach CA 92075; **Micro-Source Inc.**, Box 319, New Lebanon OH 45345; **Osborne Computer Corp.**, 26500 Corporate Ave., Hayward CA 94545; **Otrona Corp.**, 4755 Walnut St., Boulder CO 80301; **Seequa Computer Corp.**, 257 West St., Annapolis MD 21401; **Telcon Industries**, 1401 NW 69 St., Ft. Lauderdale FL 33309.

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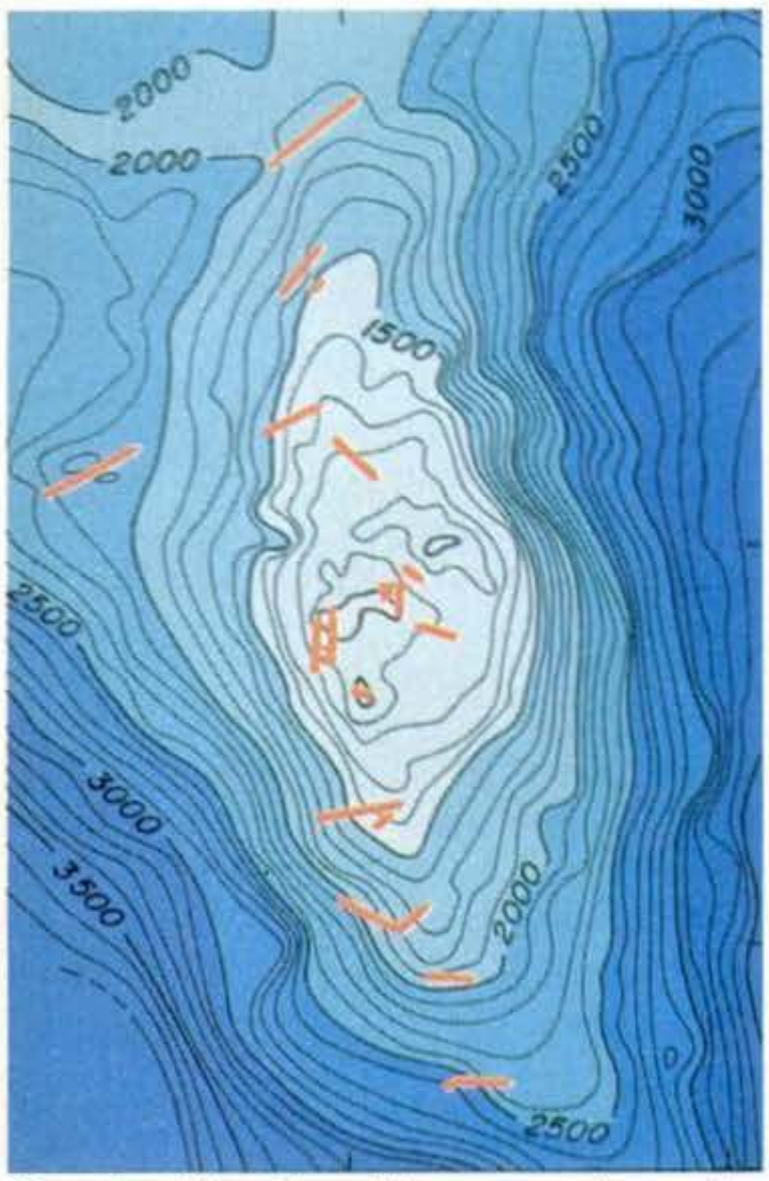
Undersea volcano

lets scientists watch the birth of an island

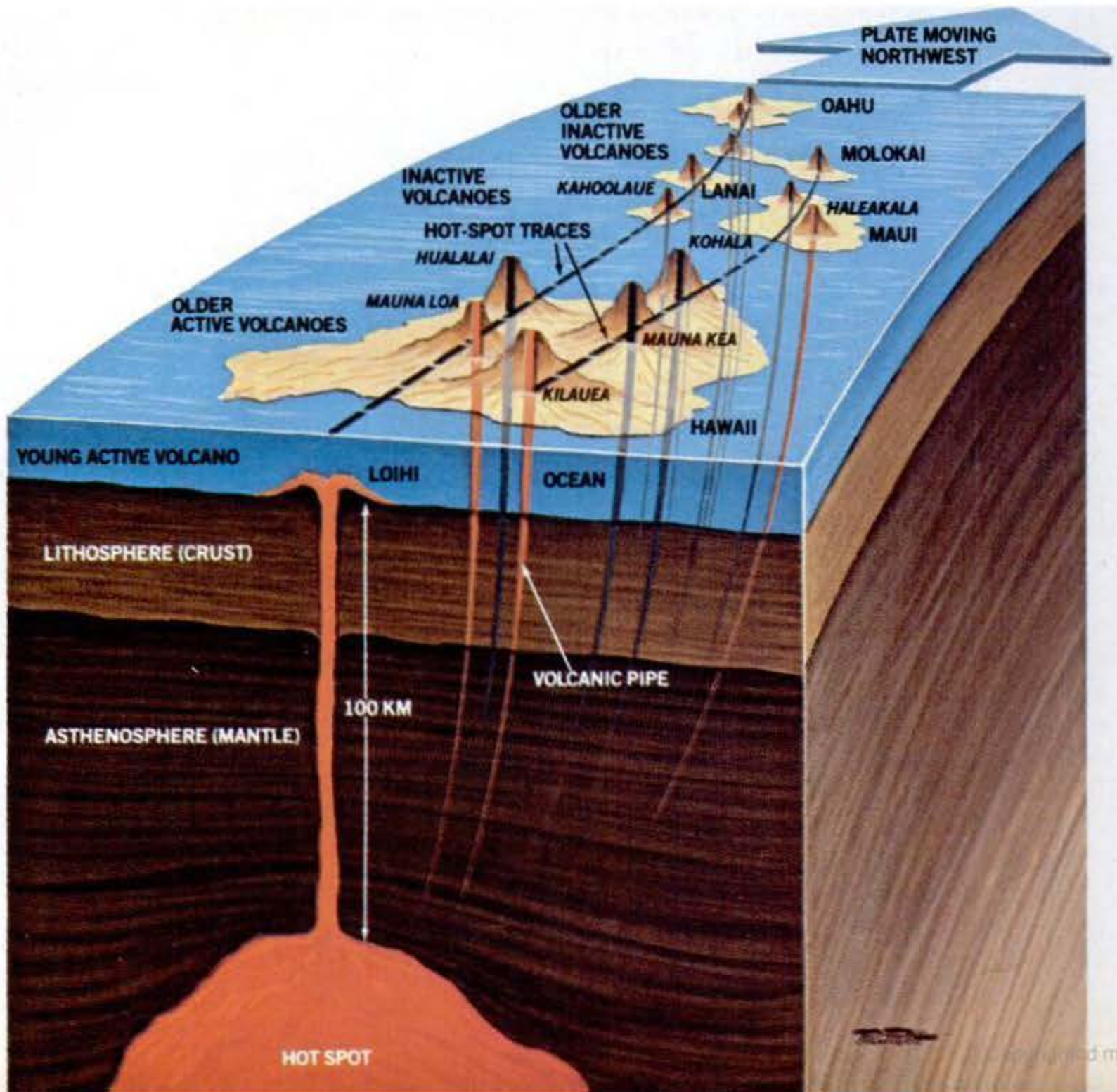
Over millions of years, Loihi's lava-strewn summit may eventually rise to the stature of Hawaii's older volcanoes (inset).

UNDERWATER PHOTO COURTESY NATIONAL OCEAN SURVEY



COURTESY U.S. GEOLOGICAL SURVEY

Already rising three kilometers above the sea floor, Loihi is built along 30-km-long ridge. Red lines show sites of USGS dredge hauls. Drawing (right) shows how hot spot has created Hawaiian volcanoes, alternately feeding two parallel traces.



Hawaii's Loihi may prove to be an invaluable Rosetta Stone of the deep

By FRED GEBHART and DANIEL RUBY
ILLUSTRATIONS BY RAY PIOCH

A land rush is building in the Pacific. Just 30 kilometers southeast of the island of Hawaii, there's a new island paradise with unspoiled beaches and not one hotel. And the only zoning restriction is a natural one: Loihi is still a kilometer beneath the surface of the Pacific Ocean.

But it's rising. An active volcano, Loihi is slowly being molded by regular eruptions of hot lava into a gently sloping conical mountain that will someday emerge from the sea. How soon? Ask the experts, and a few optimists will hazard guesses in the hundreds of years. Most think 10,000 years is more realistic. And since they are scientists, they'll insist on precision: There's a small chance it will never come up.

That kind of uncertainty will discourage the most far-sighted real-estate speculator, but scientists are doing a land-office business. In the past two years, four teams of geologists, volcanologists, and oceanographers have plied the waters above Loihi in research vessels, probing what may turn out to be a Rosetta Stone of the deep.

Loihi has already changed conventional thinking about the early stages of volcano evolution. It has also influenced what geologists know about the process of island-chain formation, and it may add significantly to the understanding of a newly discovered phenomenon called hydrothermal vents.

"I've been working on oceanic volcanoes for many years," says David Clague of the U.S. Geological Survey. "Now, all at once, Loihi has changed the way we look at everything else. It's been a very exciting time."

Actually, Loihi has been known and charted on topographical maps for many years, one of eight or 10 undersea rises in the waters southeast of Hawaii. All were assumed to be very old and geologically dead. But in 1952, spidery tracings on the seismometers at the Hawaii Volcano Observatory [PS, Nov. '78] indicated an earthquake swarm there, and Loihi was given its name, meaning "to be long" in Hawaiian.

But then the seamount fell silent and interest in it died. Meanwhile, the science of geology was undergoing a total revolution. The old view of a rigid Earth with fixed continents suddenly gave way to one in which relatively thin continental plates float on a sea of molten rock. Although similar ideas had been proposed before to explain the continental jigsaw puzzle, the new theory of plate tectonics was a consistent whole with workable mechanisms and testable predictions.

One corollary of the theory sought to account for the common occurrence of volcanic islands in linear chains. As early as 1963, J. Tuzo Wilson of the University of Toronto proposed that such islands could be formed when moving oceanic plates passed over a fixed source of lava. Later, these sources were termed "hot spots," and 12 or more were cataloged around the globe. Today, the hot-spot model remains a compelling hypothesis, but since the spots cannot be observed directly, nobody knows with assurance how they operate, how big they are, or how deeply they are buried.

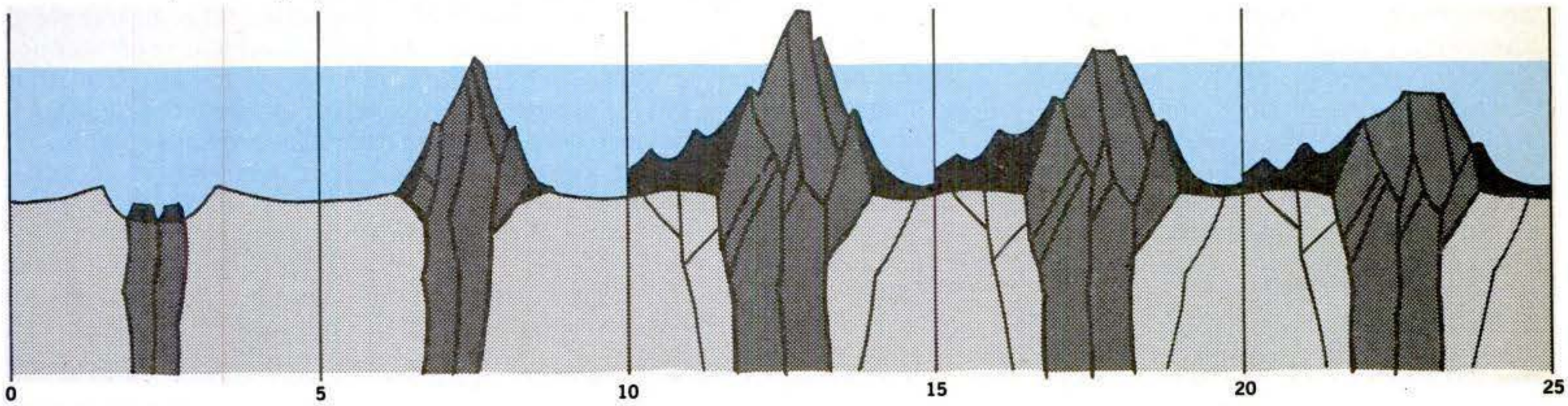
But no one doubts that a hot spot created the Hawaiian Islands and the coral atolls and flat-topped guyots north and west of them. One look at the map on the wall of David Clague's Menlo Park, Calif., office is convincing. With a pointer, Clague traces the 6,000-kilometer-long chain of 107 volcanoes, beginning with Loihi and ending at a sunken mountain called Meiji in the Emperor Seamounts off Russia. "If the oceans were drained and you saw it from space," he said, "this chain would be the most striking feature on the entire planet."

But the evidence is not merely visual. Many of the volcanoes in the chain have been studied and sampled. Their ages and latitude of formation neatly mesh with the rate of plate movement and present hot-spot location. Furthermore, their chemical makeups are closely matched. Every one of the 107 volcanoes, from youthful Loihi to distant Meiji, 74 million years old and almost washed to oblivion by the sea, was born over the same Hawaiian hot spot.

Thus, the progression of Hawaiian Islands and Emperor Seamounts provides an ongoing history of the life cycle of a mid-ocean volcano. What's been missing before now is data about the earliest stages. Until Loihi, the youngest volcano in the chain—and the most extensively studied volcano in the world—was Kilauea on the island of Hawaii. But it is nearly a half million years old. "Studying Kilauea to find out about the beginnings of volcanic evolution is like trying to study early childhood with subjects 40 years old," says Reggie Okamura of the Hawaii Volcano Observatory.

Continued

From hot spot to guyot, the evolution of an island



The islands we know as Hawaii are only the tips of the most massive mountains on Earth. They are made up of one or more volcanoes, born when the moving Pacific plate passed over a hot spot fixed deep in Earth. The volcano grows as lava erupts and collects on its flanks. Successive eruptions add more layers until the seamount breaks the surface and becomes an island. But as it grows, the movement of the plate eventually pushes it past the hot spot, and it becomes extinct. Now erosion takes over. Wind and water grind the smooth dome into jagged ravines. At the same time, the weight of the mountain proves too great for the thin Earth crust, and the island starts to sink. After many millions of years, when erosion and subsidence have reduced the once lofty island to a low stretch of sand, coral-reef building may keep it above sea level. Or it may disappear under the waves and end life as a flat-topped guyot headed for oblivion in an ocean trench.

The first indication that there was a younger subject available didn't come until 1978. On a research cruise to a nearby seamount formed when a giant landslide split off from Kilauea, USGS geologist Jim Moore also ran a routine series of soundings and other tests over Loihi, including a single dredge haul netting 300 kilograms of rock samples. There was no reason to suspect anything other than a bucketful of uninteresting 100-million-year-old rock.

Instead the dredge turned up fresh, glassy lavas so young that they couldn't be accurately dated. Equally unexpected, the rocks were coated with a thin reddish crust that resembled deposits precipitated from hydrothermal vents. Such vents had become one of the hottest subjects in ocean science since the first one was discovered near the Galápagos Islands in 1976. Since then, they'd also been found in a few other places but never in association with a conical volcano like Loihi.

Moore was naturally anxious to go back to Loihi for a closer look. But studying a volcano that's a kilometer below sea level is not as straightforward as studying one, like Kilauea, that's a kilometer above. It was two years before Moore, Clague, and Bill Normark (also of USGS) were able to get a research ship and the needed equipment back on station. By that time, Moore's initial report had excited other researchers. Alexander Malahoff of the National Ocean Survey was organizing a cruise, and groups from Scripps Oceanographic Institution and the University of Hawaii were also gearing up.

Each of these cruises had different objectives and priorities, but all used essentially the same methods: First, high-resolution, multi-beam sonar coupled to shore radar stations create accurate, detailed maps of the bottom; then, an acoustic-wave underwater tracking system is used to guide ship-towed cameras, dredges, and instrument packages to the desired location. So far, nobody has tried diving to the site in a research submersible because of the great cost and the difficulty of maneuvering it in the treacherous currents off Hawaii. That will change this summer, however, when the NOS will dive to Loihi in a Navy submersible.

First look at Loihi

The first team to get back to Loihi with a full complement of equipment was Malahoff's NOS crew. Its main interest was hydrothermal vents. These sea-bottom hot springs are of great importance to ocean scientists of all types: Their metal-rich effluents have a great impact on water chemistry; they are known to support thriving communities of exotic organisms; and they clearly play an important geological function at mid-ocean ridges where oceanic plates spread apart. But to date, there is no comprehensive theory that explains either their operation or their role.

To find vents on Loihi, the NOS team first produced a detailed map of the seamount. Here's what they found: The volcano has formed atop a long north-south ridge. At the summit is a three-kilometer-diameter caldera with two smaller pit craters inside. "It looks much like Kilauea in miniature," Malahoff said.

Bottom photographs taken by an underwater camera towed over the summit show an abundance of ropy and pillow lavas (so called because molten volcanic materials coalesce into those shapes when they contact icy seawater) within the craters and broken shards littering the lower slopes. Also, in an area near the caldera's southern rim, the photos show a field of small gray chimneys protruding from mounds like duncecaps.

A dredge haul in this area failed to bring up any of these chimneys for chemical analysis, but the coatings on lava that were recovered and high temperatures recorded by probes towed above the chimneys remove any doubt that there is hydrothermal activity. The chemical makeup of the deposits is considerably different from those taken from other hydrothermal fields, however, and no exotic life forms seem to be living near the Loihi vents. Malahoff believes that hydrothermal activity may be too infrequent to support the giant clams and worms that have been found at other vents. He also suggests that other Pacific islands and seamounts may have been hydrothermally active in the past and may now contain exploitable concentrations of scarce metals.

One month after the NOS cruise, the USGS researchers were back over Loihi. They performed similar kinds of studies, but their main interest was in learning about the early stages of eruption. Indeed, when analyzed back in the USGS's California labs, the 17 bucketsful of Loihi lavas they recovered yielded major surprises.

Island lavas can be classified as tholeiitic or alkalic. The former contains a high percentage of silica and is fluid, so it flows like water. The latter is thicker, flowing more like honey. Also, alkalic lava contains more dissolved gases, so it tends to erupt explosively; tholeiitic merely flows. All Hawaiian and Emperor volcanoes are composed almost entirely of tholeiitic lava, and standard theory said that oceanic volcanoes erupt only tholeiitic lava from birth until just before extinction, when in an explosive last gasp they give off a small amount of alkalic.

New findings, new insights

Oddly, the samples from Loihi contained more alkalic lava than tholeiitic. Moreover, the alkalic lavas had a thicker coating of a characteristic yellow rind that forms on all lava as it reacts with seawater, indicating that the alkalic lava was older than the tholeiitic. This may not seem earth-shaking, but it helps overcome a long-standing problem about oceanic volcanoes. Geologists, Clague explains, have always been puzzled as to how the first magma from Earth's interior is able to get through the thick, tough crust. Does it burn through, find cracks, or what?

"The gas content of alkalic lava would allow it to actually blast its way through," Clague says. "That also means that alkalic magma is less dense than the surrounding material in the mantle. This helps you get it out of the interior of Earth and up toward the surface."

With this new insight, researchers will now go back to other oceanic volcanoes to look for evidence of an early alkalic stage in their evolution.

Analysis of the Loihi lavas produced another surprise that may influence theories about the workings of hot spots. Few features on Earth are truly primitive; most rocks have been involved in a series of geological upheavals during the course of the planet's 4½-billion-year history. This is true of most volcanic lavas, as well. But Loihi lavas have a very primitive chemistry. "In fact," says Clague, "it's the most primitive source ever found—one that hasn't been tampered with by any geological processes for billions of years." That suggests that the Hawaiian hot spot is buried much deeper than was previously believed. But data from other hot spots tell a different story, so the mechanism at work remains an open question.

There will likely be more questions raised and answers provided as research on Loihi continues. Some will have to wait until the volcano erupts next. "There's no way to predict when that will be," Clague admits. But seismographs and other instruments are constantly listening for early warnings, and the USGS has plans to dispatch a research ship at the first hint of activity. "We're not going to miss the chance to watch Loihi in action," Clague says. PS

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You float on air in this new-sport **flight chamber**

Engineering picks up where nature left off: Now humans can fly

By JAMES A. BAGGETT

Man's oldest dream has come true. With the aid of a DC-4 propeller spinning beneath a screened and padded room, thousands of Nevada thrill-seekers and would-be sky divers have learned what it's like to soar like a bird on a cushion of air. Now, if the first vertical wind tunnel (which opened in Las Vegas in October '81) is joined by franchised Flyaways the world over, then Airflite Associates' dream will have come true, too.

The company expects indoor free-falling to become "a great new thrill sport—no simple sideshow amusement," according to Airflite's marketing manager, Harry Carman.

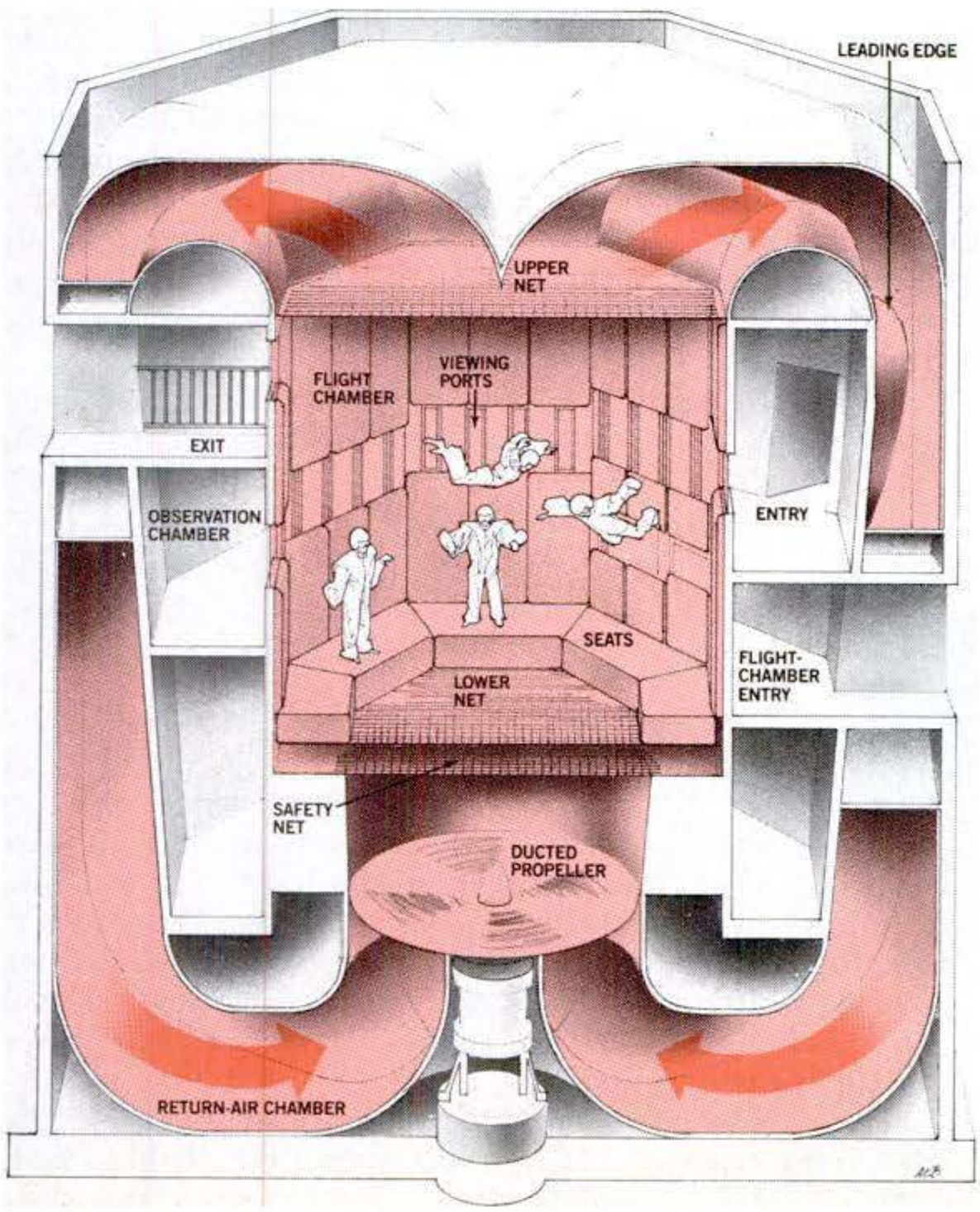
The idea was originated by a Quebec farmer and flight enthusiast, Jean St. Germain, who built a working prototype in a silo on his farm near Montreal and then sold patent rights to Airflite. But turning the crude original into an aerodynamically efficient and economically feasible structure involved some creative engineering. Architect Alan L. Blum—also a pilot—designed the Flyaway in three concentric octagons, avoiding the need for expensive slip-formed concrete cylinders.

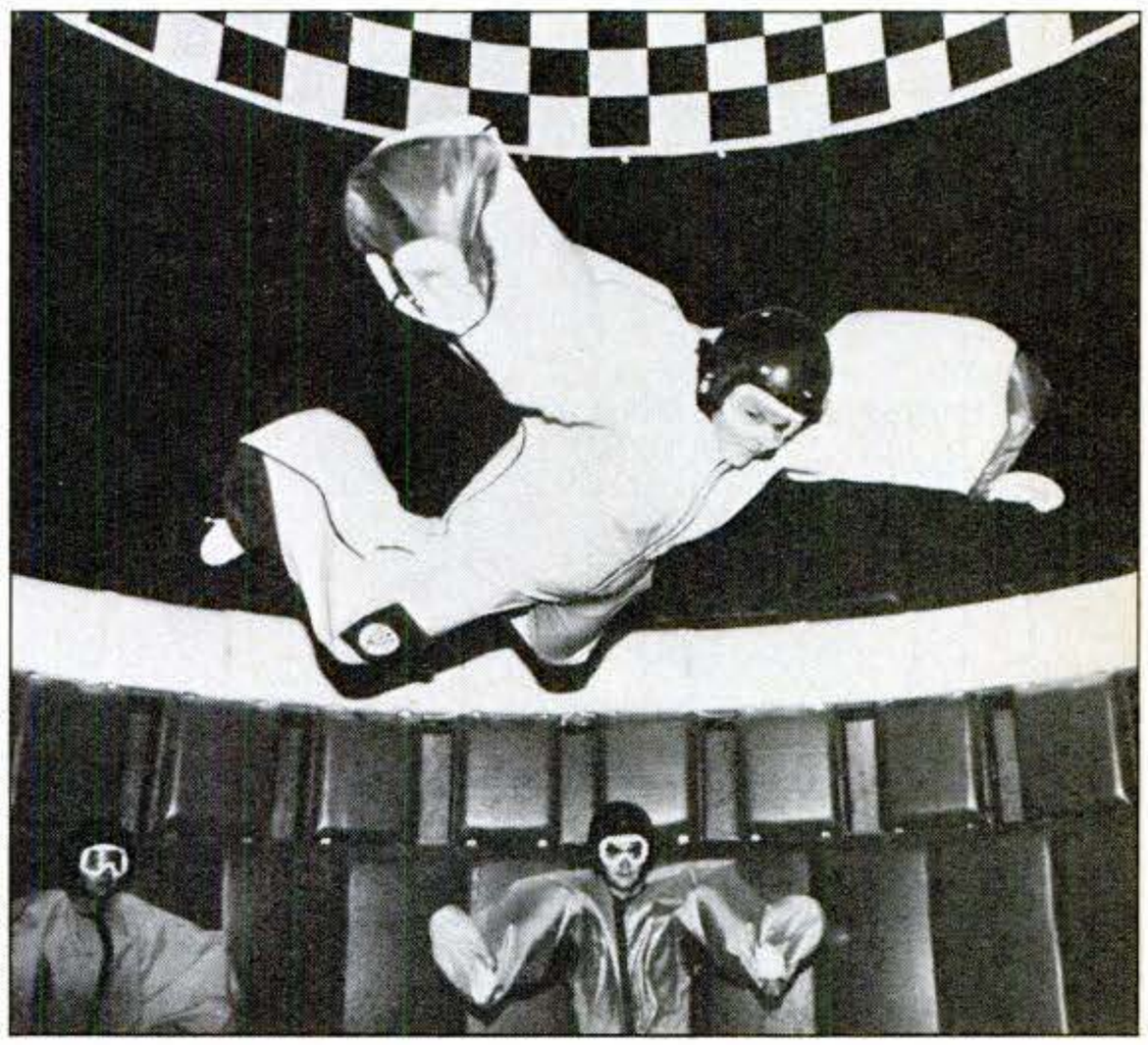
The inner octagon, 20 feet across, forms the flight chamber. A double layer of heavy cable netting protects flyers from the 13-foot-diameter three-blade prop spinning below; a third layer 20 feet above restrains them from sailing out the top. The second octagon encloses an observation area, where a ramp spirals upward to offer views of the action. Entry and exit tunnels connect the flight chamber and observation area to locker and instruction facilities in an adjacent building.

The outside octagon forms the return-air chamber, necessary to isolate the structure's interior from extreme outside temperatures. Even with recirculation, air conditioning is needed to remove the 1½ million Btu per hour added to the air by friction with the concrete walls.

The need to return the air from top to bottom also raised some aerodynamic complexities, which William Bettes, wind-tunnel director at Caltech, was called in to solve. He carefully determined the ideal curvature of the 52-foot-high return-air chamber to minimize unsteadiness and turbulence caused by suspended bodies in the flight chamber. He also designed aerodynamic leading and trailing edges for the access tunnels, which pass through the return-air chamber. And he added a close-fitting cylindrical shroud around the propeller to increase the lift-to-drag ratio of the blades.

The structure had to be built exceptionally strong to withstand the asymmetrical loading on the walls caused by the reversal of wind direction. The roof is designed to accept a 25,000-pound load. The outside wall panels, poured on the ground and tipped up, are of eight-inch-thick concrete and weigh 52 tons each. PS





No strings attached: A woman soars in a column of air in the Canadian prototype of the human wind tunnel. Wearing special winged suit designed by a well-known parachutist, she "takes off" by leaning into air stream, maneuvers with arm motions and body tuck. Helmet (with built-in earphones playing music or instructional tips), goggles, and soft-sole shoes complete flight outfit. Prototype got complete redesign (drawing) for efficiency and safety. Las Vegas Flyaway can support up to four adults at once on 80-to-130-mph air cushion generated by three-blade prop spun at 1,200 rpm by 600-hp electric motor.

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Now, from Polaroid, it's **instant slides**

By EVERETT H. ORTNER

Problem 1: You're going on a long vacation trip, and you suspect that your camera isn't working right. Problem 2: You want to photograph a complicated indoor setup, and you'd like to check the lighting before you record it on Kodachrome. Problem 3: You're giving a slide-illustrated talk tomorrow morning at your company, and you'd like to include some last-minute data. Problem 4: You're an impatient guy, and you want to see your slides *now,* right after you take them.

With Polaroid's new 35-mm slide films, you can solve all of these problems fast—say, in three minutes. That's about how long it takes to process an exposed roll—either color or black and white—with which you can check exposure and lighting, and with quality good enough for almost any routine purpose.

The technology of the new slide films is based on that of Polavision—the wonderfully inventive instant-movie system that failed in the marketplace [PS, Aug. '77]. Polachrome, the color film, is basically a black-and-white film with triplets of primary-color dye stripes—red, green, and blue, 1,000 triplets to an inch—that act as filters. When you snap the shutter of your camera, the stripes filter the incoming light—each stripe admitting its own color and blocking other colors. The black-and-white silver-based emulsion behind the stripes is thus exposed in a pattern determined by the color filtration. When the processed film is projected, light, now going first through the black-and-white base, is again filtered by the colored stripes, in the same pattern in which the film was exposed. The result is a color image faithful to the original.

The fine lines in the film are visible, but faintly and not intrusively. The grain is of a quality, perhaps, like that of high-speed Ektachrome exposed at twice its normal speed and push-processed. Image stability? Equal to that of conventional "chromes," says the bearded scientist from Polaroid who developed the films, Dr. Samuel Liggero.

There are three Autoprocess films:

- Polachrome color film, ASA 40, in either 12- or 36-exposure rolls.
- Polapan continuous-tone black and white, ASA 125, in 36-exposure rolls.
- Polagraph high-contrast black and white, ASA 400, in 12-exposure rolls.

When you buy a roll of Autoprocess 35-mm film, you also get a processing pack. It's good for only one roll. The two will sell for about the cost, plus processing, of specialty color films—say, $12 for a 36-exposure roll.

You also, of course, need an Autoprocessor. This four-by-four-by-8½-inch machine weighs about 1⅓ pounds. With Polaroid's slide mounter—an ingenious device that turns film into slides almost as fast as you can feed in the hinged mounts—plus 100 mounts, it will sell for, Polaroid says, less than $100.

When can you try the new system? Look for it this spring. PS

From Agfa, it's one-dunk, one-wash color prints

No stacks of trays, no fancy equipment: With the new Agfachrome-Speed system, you need only one tray containing an activator solution to turn a color slide into a color print. The drawings above show the steps: inserting the slide in the enlarger negative holder; setting filtration; (in darkness) putting Agfachrome-Speed paper in the easel, exposing it, and sliding it into the processing tray; washing, judging the picture to see if all went well; and, finally, drying.

Agfa really means that "speed": Only 90 seconds are needed in the activator solution to develop and stabilize the print. After that, you turn on the lights and wash for five minutes. Temperature: between 64 and 75 degrees F. Diluting the activator increases print contrast. A pinch of potassium bromide softens contrast. A curiosity: You put the slide in upside-down in your enlarger. And you expose the paper through its back.

I found the prints very attractive: good color, good sharpness. Agfa expects to bring the system to the U.S. in mid-1983.—*E.H.O.*

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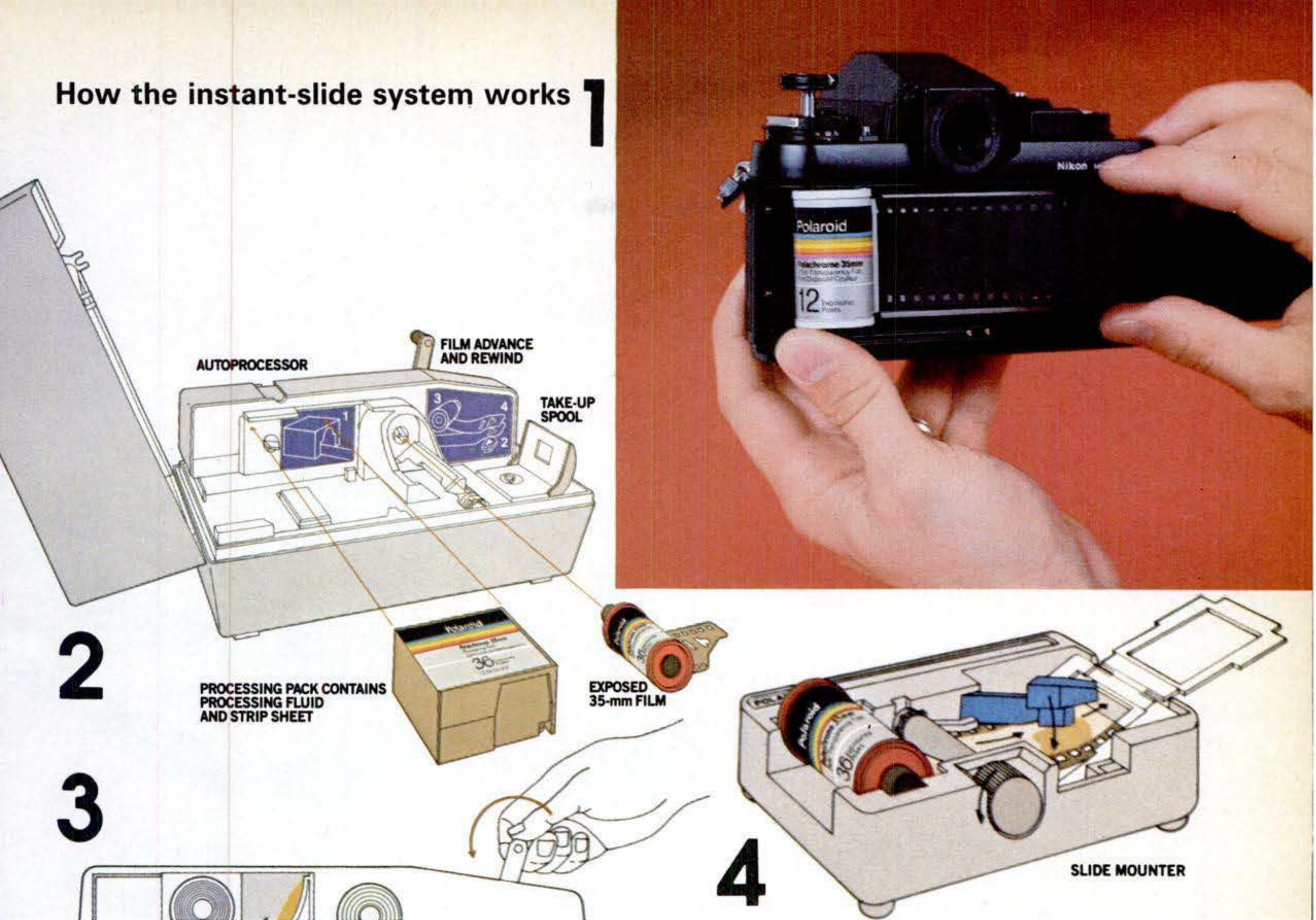
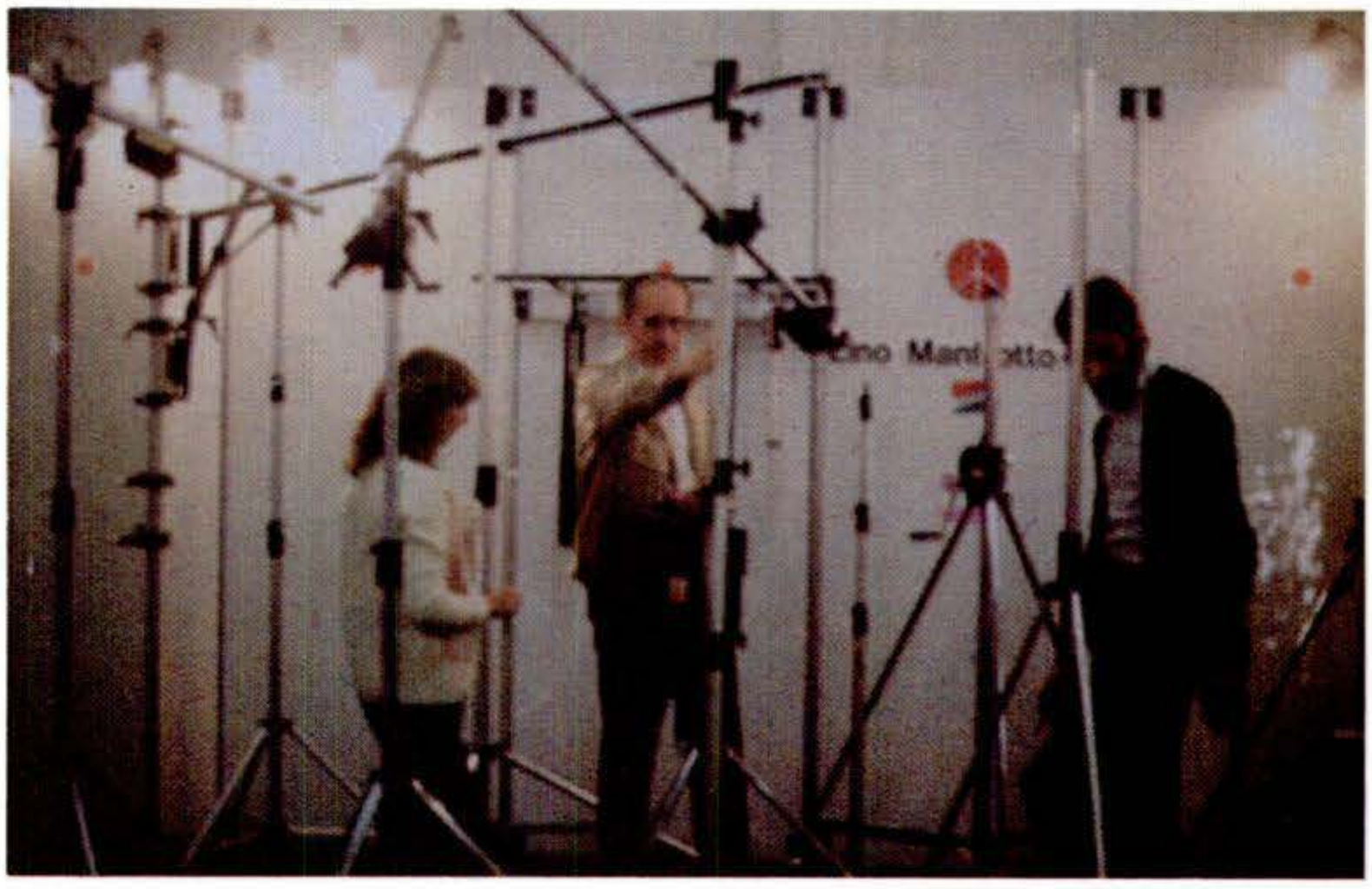
How the instant-slide system works



Polachrome film loads (1) like any 35-mm film. After exposure, cartridge is placed in Autoprocessor with processing pack (2). Strip-sheet leader from pack and film leader are attached to take-up spool and, with cover closed, both are wound together (3). Reagents in fluid now reduce exposed silver halide grains to negative silver. On rewinding, one minute later, strip sheet strips away top layers of film containing negative, leaving positive silver image. Both strip sheet and film are rewound. Film, processed and dry, is slipped into mounter (4) to be cut up and set into 2×2 slide mounts, ready for projection.

Slide quality: surprisingly good



Limited PS test was made under worst conditions: outdoors on rainy day, indoors (pictures here) under fluorescent light, but colors proved quite accurate nonetheless. With best lighting, colors are very good. Color stripes, necessary to additive process (see text), and grain are both visible but not disturbing.

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PROBE IV

Ford's new wind-cheating supercar

Only 2½ hp are needed to move this car at 50 mph down the highway

By HERBERT SHULDINER
PAINTING BY DEAN ELLIS

TURIN, ITALY

"This is where art and engineering merge," Filippo Sapino said as he led me into the small Ghia factory here in northern Italy. Four workers were busily engaged in the final building stages of Ford's astonishing new show car, Probe IV—the world's greatest wind-cheating automobile. The car is a product of Ford's most advanced styling and engineering concepts, yet it was hand-built with methods that more closely resemble the art of sculpture than auto building.

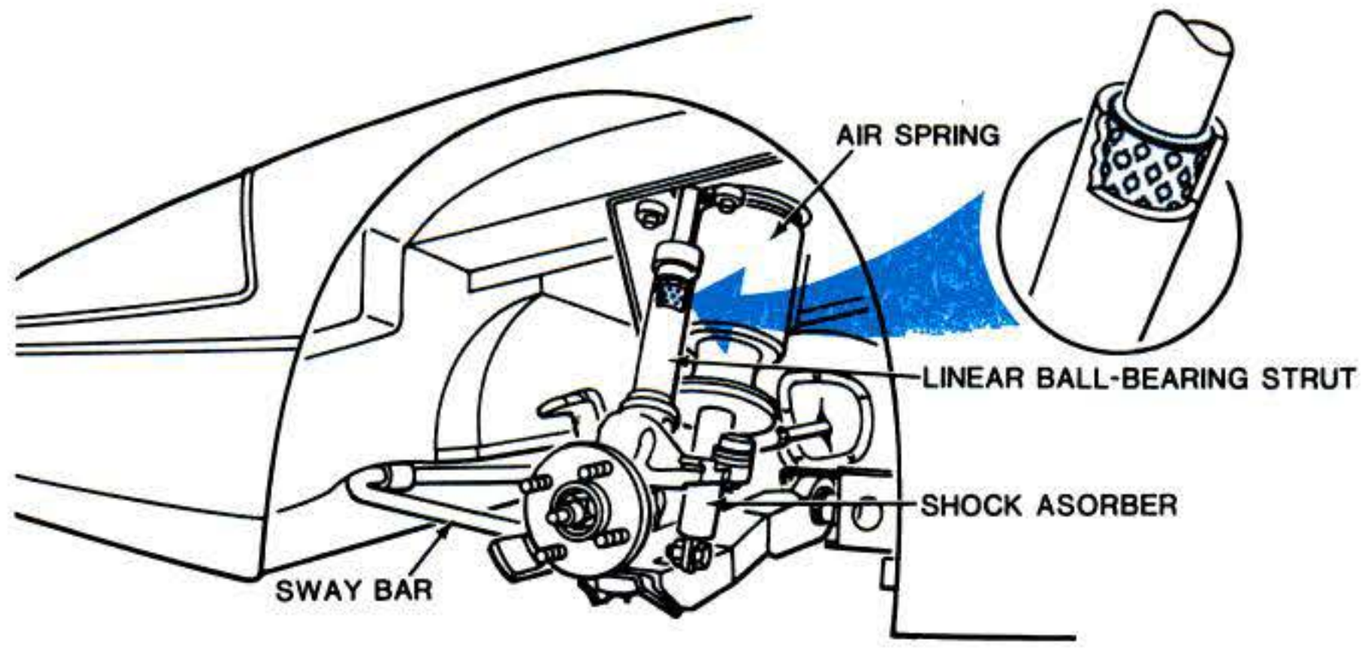
Probe IV has a remarkable 0.15 coefficient of drag (C_d)—lowest ever for a four-passenger sedan—and it bristles with unique engineering features:

- A computerized air-suspension system that raises and lowers the car to give it the best aerodynamic angle of attack at all speeds.
- A computerized deployable front bottom spoiler.
- Flush-mounted fixed side windows (with a small panel that opens to permit payment of tolls).
- An engine tilted at a 70-degree angle from the vertical so that it can fit inside the sloped hood.
- A futuristic interior with motor-driven adjustable seats.

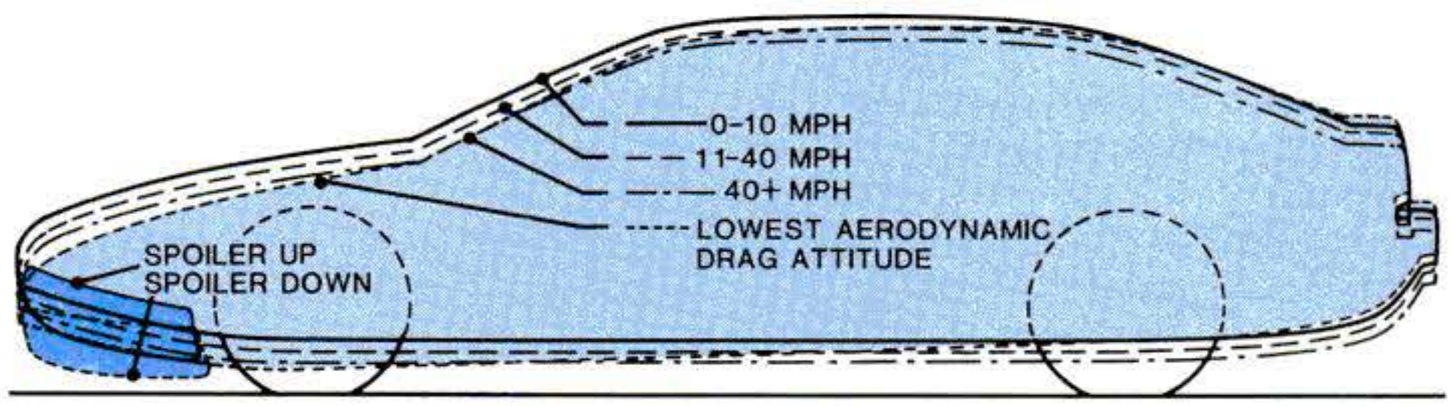
I recently traveled to Ford's design headquarters in Dearborn and its Ghia studios here in Turin to talk to the engineers and designers who created this unique car. I also watched it being built and interviewed the people who supervised the process.

"Many of the features in the Probe IV are quite new to Ghia," Sapino told me. Since 1975, Sapino has been managing director of the famous Italian design firm where the Karmann-Ghia and numerous other design firsts were born. "In fact, there were so many new things about the car when we got the project that it was difficult to even estimate how long it would take to build," Sapino continued. But the car was completed in a little over four months, compared with the six months or more Ghia usually requires to build a prototype, he said. It has now been shipped to the U.S. for wind-

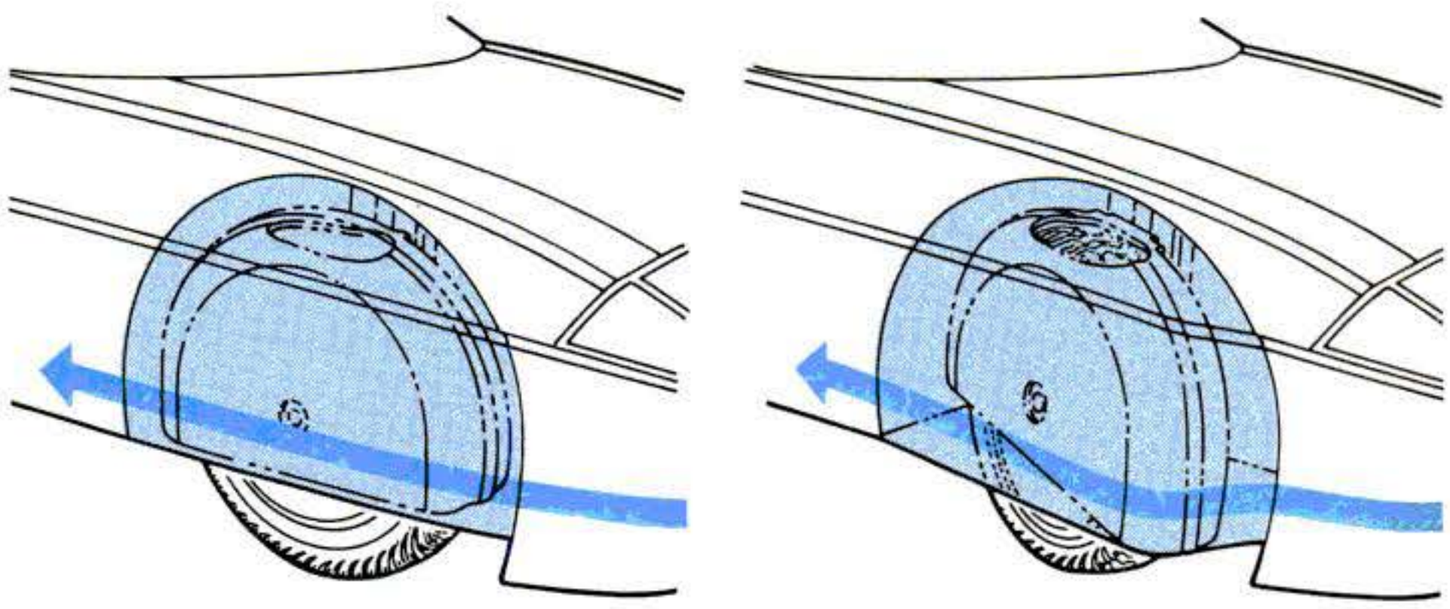
Continued



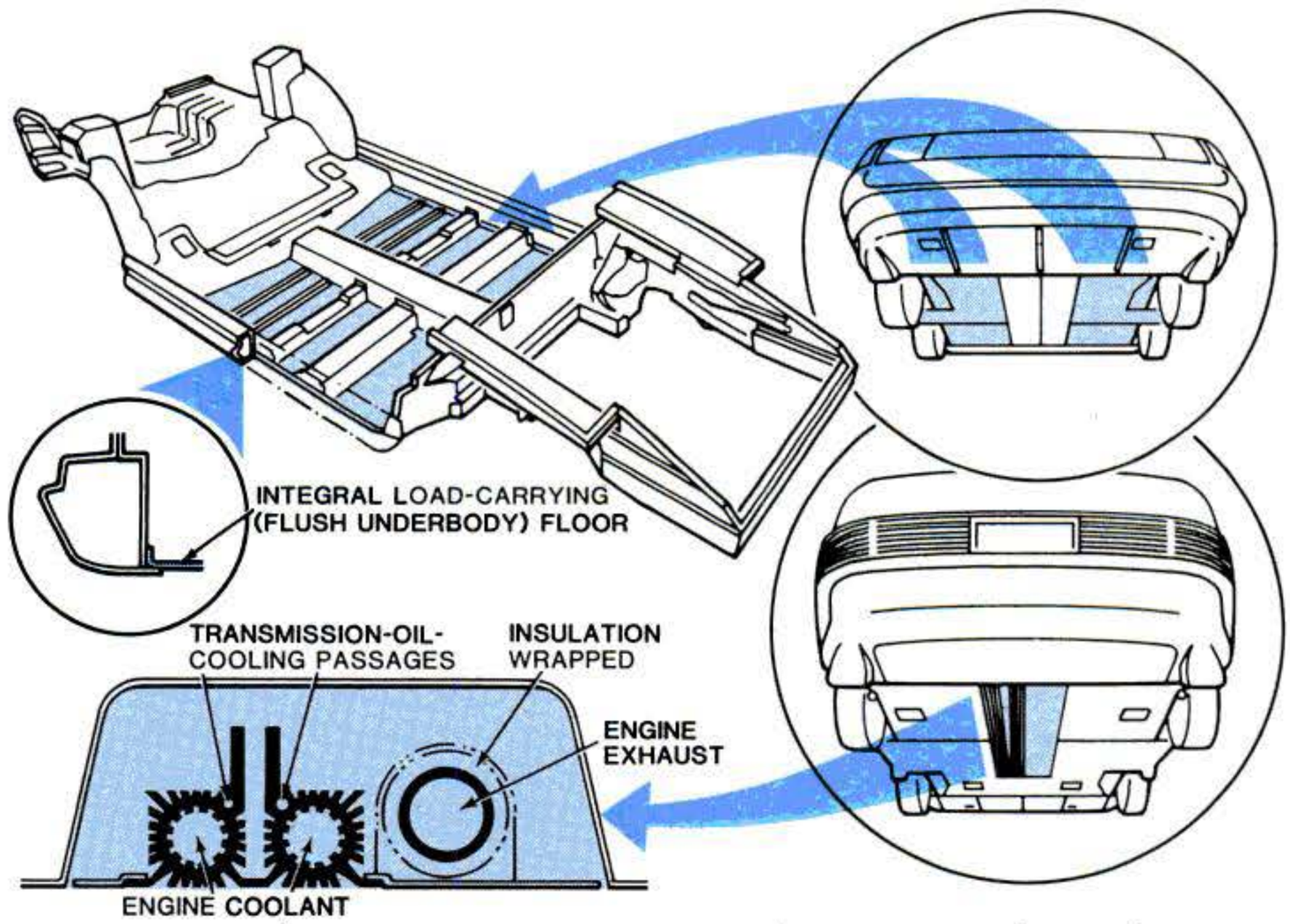
Chopped-down MacPherson struts use a new ball-bearing design to prevent suspension binding at high side loads. Air springs are computer controlled.



Computer constantly keeps car at its optimal attitude for aerodynamic efficiency. At over 11 mph, the car drops one inch. It drops another two at over 40.



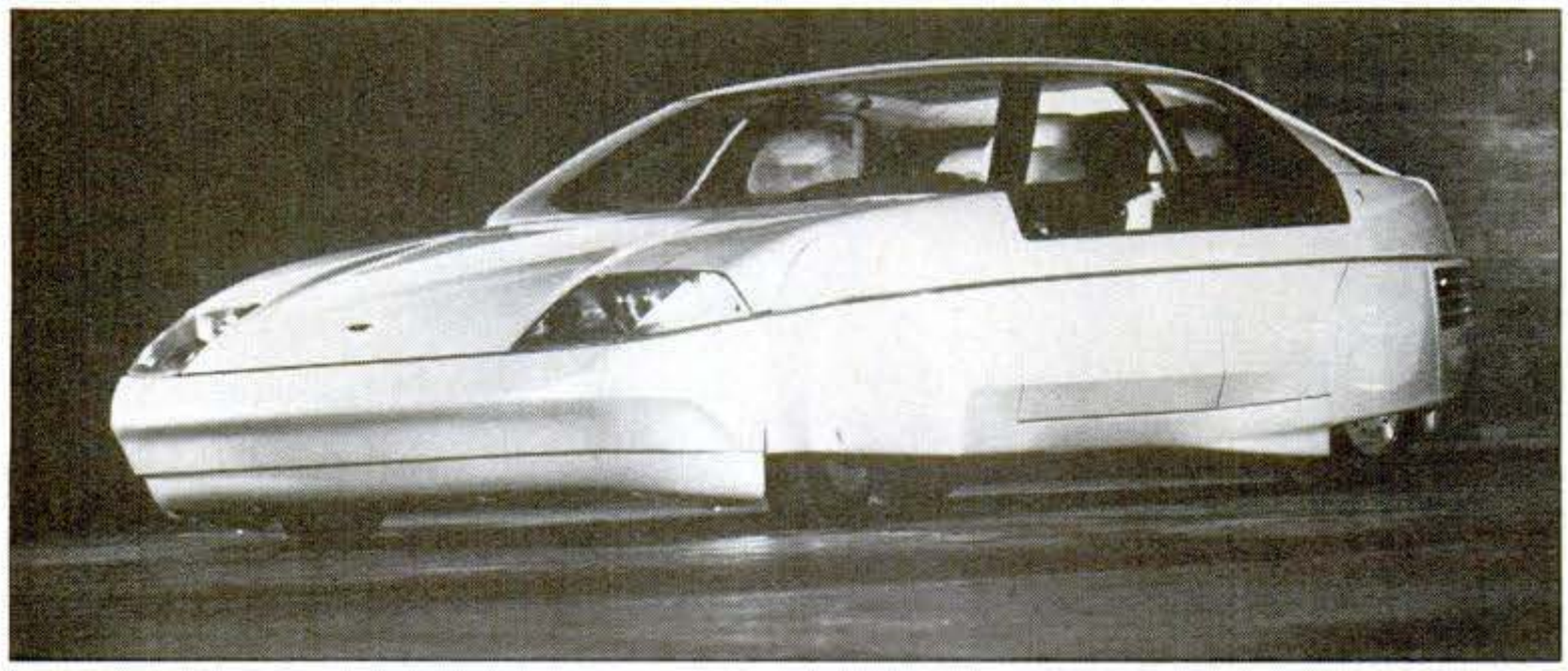
Unique inner fender deflects front wheel-well covers outward during full turns. The rubber covers revert to original shape after turning.



Car bottom is completely sealed to aid aerodynamic efficiency. Finned aluminum ducts carry engine coolant to rear radiator. Ambient air also cools.

ILLUSTRATIONS BY RUSSELL VON SAUERS

Cutaway painting of Ford's Probe IV reveals novel engine installation, as well as placement of radiator and air-conditioner condenser. Arrows show air flow.



Nearly completed Probe IV is shown at Ghia design studios in Turin, Italy, late last year. Note the glass-covered three-in. rectangular headlights.

tunnel testing. As this issue went to press, it was scheduled to be exhibited in a series of auto shows starting with the Detroit Auto Show in Cobo Hall in mid-January.

The building of the Probe IV in Italy completed an 18-month project from the time the car was first conceived. "This is the first car we ever developed on a computer," Donald F. Kopka, Ford's vice-president of design, told me at the maker's design center in Michigan. "The designer worked with a computer operator, and they fed in the key package information. Then they actually did the surface development of the vehicle on the cathode-ray tube," Kopka said. "Once the shapes were developed, we took the tape from that and carved out a three-eighth-scale clay model."

The finished exterior design is a five-door notchback sedan. It features totally enclosed front and rear wheel wells, a completely sealed bottom, a blocked-off front end with intake ports behind the rear wheels, and a cowl only 30.8 inches above the ground. "I don't think there's another front-engine car with a low cowl like this," says Charles Haddad, manager of advanced engineering of Ford's design staff.

Ford modelers and designers took the scale model to the University of Maryland wind tunnel to fine-tune the design. "We did a lot of development on side-view mirrors because they add frontal area," Kopka said. "We got them slippery enough so that they almost compensate for the frontal area they add." The total frontal area of the Probe IV is 20.5 square feet. Even the most minute features had to be carefully worked out at this stage, he told me. "At this level of efficiency, even putting a name plate on the side of the car would have a measurable effect on aerodynamics."

Initial testing of the final design revealed a 0.17 C_d, Kopka said. Two full-scale fiberglass models were built—one for additional wind-tunnel testing, the other to be shipped to Italy to serve as a model for the actual prototype. "We expected the C_d to degrade to 0.18 when we went to the full-scale model," Kopka said. "But we actually broke through in the full size and came out with 0.152."

Meanwhile, as the aerodynamic testing went on in the U.S., the Ghia craftsmen here used the other fiberglass model as a pattern for the finished sheet-metal parts of the prototype. Each steel part was hammer-formed in a process that Italian artisans use to create art objects. The Ghia workers are so skilled at this that I couldn't spot a dent on the sheet-metal exteriors I examined.

Although the Probe IV is visually striking, its under-the-skin engineering features are even more remarkable. The car is built on a specially designed chassis and uses the 1.6-liter (97.6 cu. in.) engine and automatic transmission power train from the Ford Escort. Because the Probe IV has such a low cowl and sloping hood, Ford engineers had to tip the engine an astonishing 70 degrees from the vertical. "But you can't just tip the engine," says Charles Haddad. "The casting won't match the holes in the power train." So the engine casting had to be cut, rotated, rewelded, and patched to fit.

The low cowl also created problems when the engineers tried to install MacPherson struts, Haddad says. "They stuck up five or six inches too high." The struts had to be chopped down to fit. The engineers also designed a ball-bearing fitting for them (see drawing on previous page).

Because the front end is completely blocked, engineers had to find an appropriate place for the Probe IV's radiator and air-conditioning condenser. The solution? "We use a kind of wasted area behind the wheel housing," Haddad says. The radiator is on one side and the condenser on the other. Intake vents behind the rear wheels cool these components.

An ingenious system allows the vehicle to turn despite the fact that the front wheel wells are covered to increase aerodynamic efficiency. Unlike the rigid steel panels that cover the rear wheel wells, a flexible synthetic-rubber membrane covers the front ones. In addition, the ultra-low-rolling-resistance 155/75R16 Goodyear tires are covered with a Kevlar fender. The inside fender pushes the flexible membrane out only during full turns (see drawing).

The windows, windshield, and backlite of the Probe IV are unique. The side glass is flush-mounted—even covering the A-pillars, except for a small panel at just the right height to allow a driver to reach out and pay tolls. The windshield is made of triple-curvature glass yet is remarkably distortion-free. A special windshield-wiper system with one large and one small wiper was designed to sweep the front glass. The Plexiglas backlite has a double curvature.

Probably the most unusual engineering feature of the car, however, is the computerized air-suspension system. It's designed to give the car the best attitude for aerodynamic efficiency. Between zero and 10 mph, the car has a 6½-inch ground clearance. At 11 mph, ground clearance is reduced by an inch. "When it passes 40 mph the car starts to tilt more, with the front dropping faster than the rear," says Haddad. At 45 mph, the deployable front spoiler drops, and the rear end rises—having found the optimal attitude for aerodynamic efficiency. At this point, ground clearance is three inches.

The Probe IV's C_d of 0.15 is half that of the most aerodynamically efficient production car today. (Audi 100 has a C_d of 0.3.) A car with a C_d of 0.3 needs five aero-hp to move it down the road at 50 mph. The Probe IV needs only 2½ aero-hp to move it at 50 mph. That could result in considerable fuel savings.

Ford's Donald Kopka said there are no immediate plans to turn Probe IV into a production car. But he predicted that some of the prototype's systems will eventually find their way into the market. A version of the computerized air-suspension system will be used in the 1984 Lincoln Continental and Mark VII series. "By 1987, other Probe IV principles will find their way into production cars," Kopka said.

Ford is already designing an even more aerodynamically efficient Probe V, Kopka added. "We don't know what the practical limit is in lowering C_d, but our next objective is to build a car with a C_d of 0.12 or 0.13." PS

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Is it a bird? Is it a plane? No, it's an ultralight/ hang glider/ dune buggy/ airboat/ seaplane

All-terrain vehicle from a kit lets you soar or steer over sand dunes

By BEN KOCIVAR

Swooping over fields and treetops in an ultralight aircraft [PS, Jan. '82] is an exhilarating experience. Between flights these agile personal planes are usually taken apart and stored.

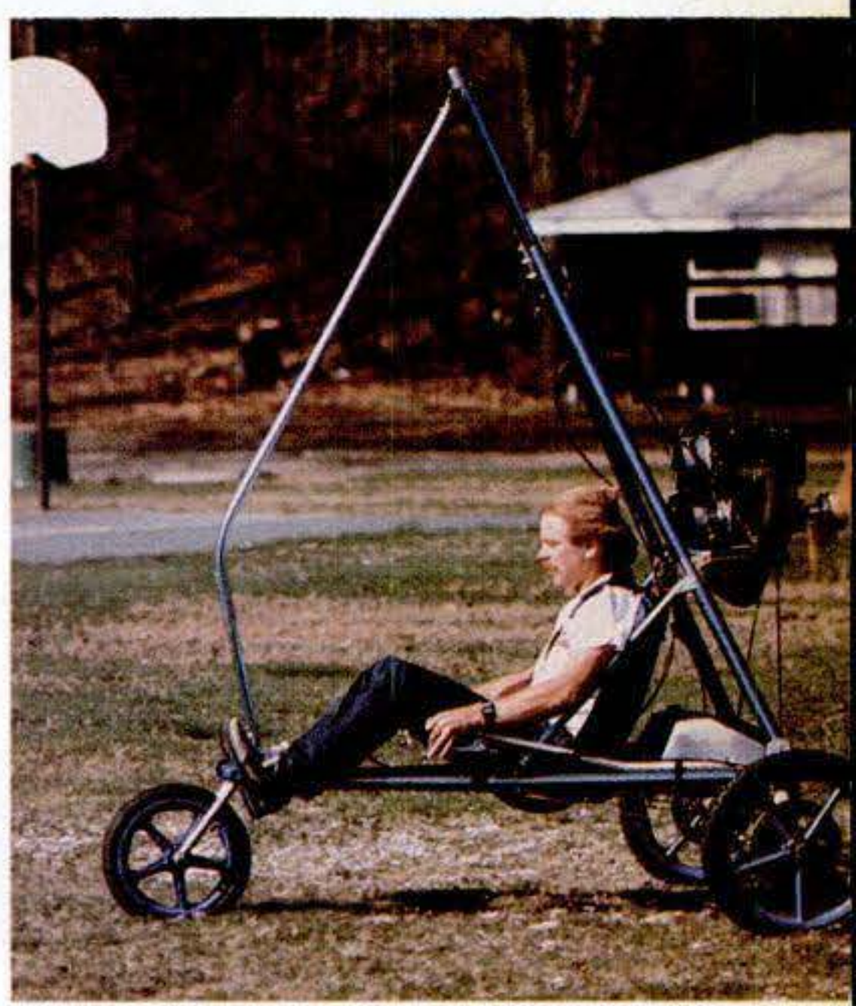
Flight Designs Inc. (Box 1503, Salinas, Calif. 93902) figured the Kawasaki 440A engine in its ultralight shouldn't collect cobwebs on the ground, so it designed the Jet Wing all-terrain vehicle (ATV).

Jet Wing ATVs are sold as kits ($4,791) that go together with hand tools in about one day. A few minutes' work converts the basic ultralight into four other transportation vehicles. A sixth mode is in the works.

First, you can use any of the three delta-type wings marketed with Jet Wing for simple hang gliding. Substitute optional floats for trike wheels and the ultralight becomes a seaplane. You'll lift off the water at about 23 mph and cruise at 35 mph while you explore rivers and lakes from the air. Take off the wings and add a rudder, and the seaplane becomes a prop-driven airboat capable of speeds over 40 mph.

For use on land, remove the wing, add brakes, and either substitute balloon tires to create a dune buggy or use the regular trike tires. "You can use it for flying, boating, racing, hunting, or fishing—and next winter we hope to perfect a set of skis," says Alan Levinson, Flight Designs president.

You won't need a pilot's license to fly a Jet Wing, owing to its weight and fuel-tank limits. A brief training course comes as part of the sale. But considering the hazards, further instruction from an experienced ultralight pilot is wise. PS



Shifting your weight (top) controls Jet Wing ATV in flight. Optional $1,500 floats (top, inset) and rudder convert ultralight into airboat or seaplane. Removing wing and bolting on handgrip brakes changes plane into go-cart (above).

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Bantam-weight backpacking

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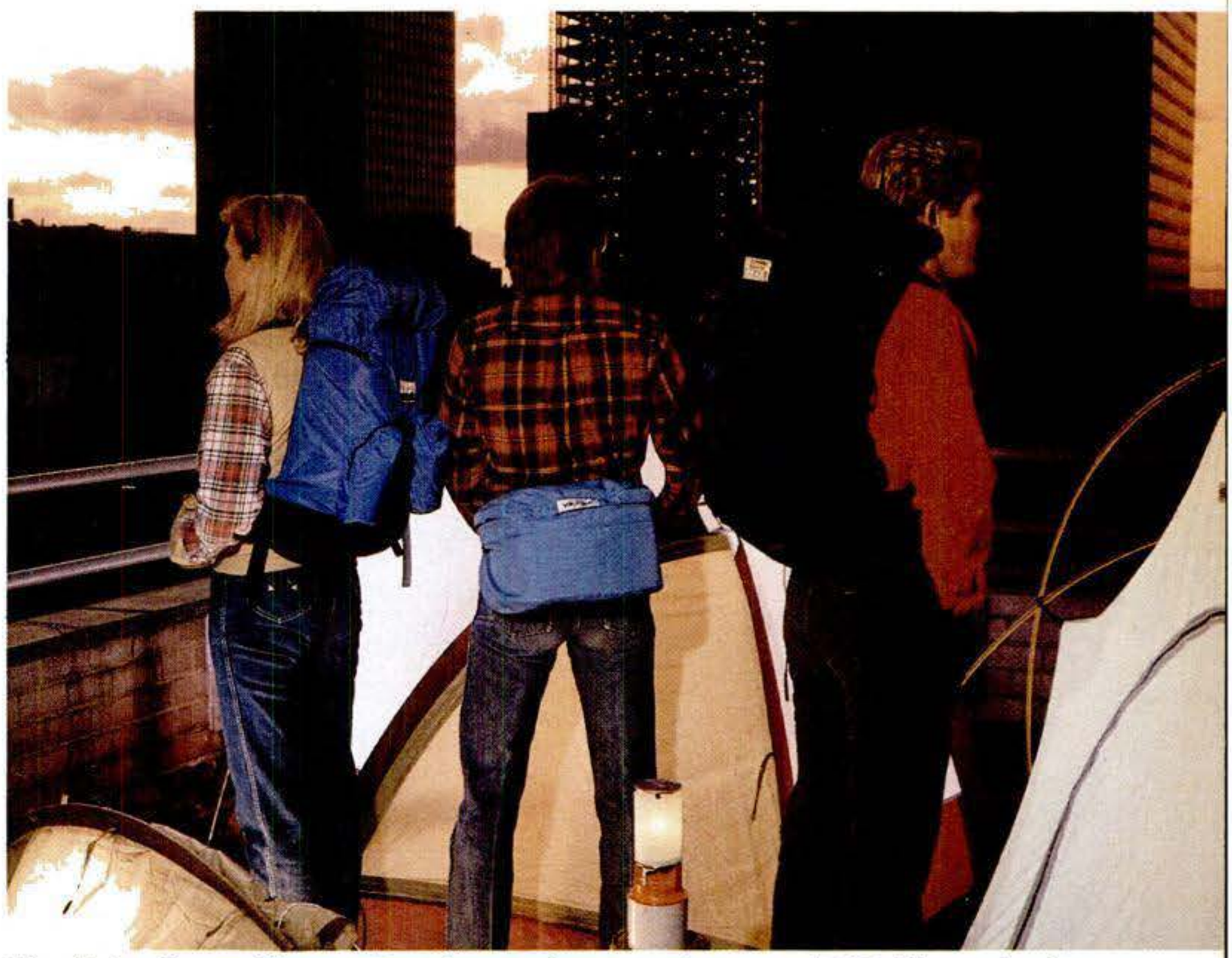
Take a load off your back with ultralight gear that boasts quality and comfort

By V. ELAINE SMAY
PHOTOS BY GREG SHARKO

If the heights you scale aren't the Himalayas, the gear you need to get there doesn't have to be expedition weight, either. The new ultralight gear featured by many major outfitters offers comfort and quality while paring pounds from your load—an achievement worthy of a celebration.

Most of our sampling of new equipment is gleaned from ultralight lineups. Two exceptions: the Coleman pack and the Slumberjack sleeping bag. We included the former as an example of Coleman's new line of internal-frame packs. The latter is one of the first bags to use Du Pont's new Quallofil insulation ["What's New," PS, Oct. '82]. Quallofil is the closest man has come to duplicating the loft and softness of down, says Du Pont. And unlike down, it keeps its warmth when damp. One of our ultralight bags also uses Quallofil. Lightweight tents for one, two, or three, a plethora of packs, and a reliable emergency light complete our roundup. PS



Ultralight, internal-frame Tourlite pack from Alpenlite (left) has 1,600-cu.-in. capacity. It's made of waterproof nylon, weighs 18 oz., carries up to 20 lbs., and sells for $60. Double-Up Pack from Yak Works (center) can be used three ways (see photos at bottom). Coleman has added internal-frame packs to its Peak I line. The Model 680 (right) has a 4,013-cu.-in. capacity, costs $110. It's made of waterproof Cordura nylon and adjusts to fit five-ft.-two-in. to six-ft.-five-in. hikers. All packs shown have quick-release plastic buckles. Alpenlite and Peak I have adjustable (and removable) chest straps, foam pads for back comfort, and numerous lash tabs. Both companies make smaller and larger versions of these packs.

Trio of nylon tents features breathable sides and waterproof floors and flies. Cricket I from Moss Tent Works (facing page, tan tent on left) is a three-lb. shelter for one. Integral rain fly can be tied up for stargazing or staked out for weather protection ($142). Moss's Olympic (center) can sleep three—it's 119 by 72 in., 52 in. high, weighs 6½ lbs., costs $299. Two-person Sphinx from Sierra Designs (right) clips to poles for simple setup. It's 93 by 67 in. and 52 in. high, weighs six lbs., costs $279. Goose-down sleeping bag (right foreground), the 4-Way Ultralight can be used alone (rated to 40 deg. F), as a bag liner, as a comforter, or two can be zipped together. It's $139 from Eddie Bauer. We've slipped into it a Silver Liner ($50) from Early Winters, which extends a bag's comfort range by reflecting radiant body heat. One Kilo Bag (the red one) from Early Winters has a Silver Lining built in. Bag is filled with Du Pont's Quallofil, weighs 2.2 lbs., and is rated to 32 deg. ($98.50). Expedition-quality bag, the Everest Elite by Slumberjack, is also filled with Quallofil. This one is rated to 20 below, weighs about 6⅓ lbs., costs $199.

Tiny light from Tekna (1¼ by four in.) uses a lithium battery, which has a 10-yr. shelf life; krypton-gas-filled bulb gives a surprisingly bright light. Mini-Lith is waterproof to 2,000 ft., weighs two oz., costs $20. Seven-oz. fanny pack was designed for a runner who set a new record on the 220-mile John Muir Trail. Main pocket holds 320 cu. in.; side pockets are removable. Alpenlite and Early Winters sell the JMT Case for around $40.

Double-Up Pack ($37 from Yak Works) starts as a 500-cu.-in. fanny pack (far left), to which you can add a nylon-covered foam insert (the Lensert, $27) to convert it to a camera case. Velcro strips on the Lensert let you customize it to fit your gear. When you need more room, just unzip a top pocket in the fanny pack and pull out an upper compartment, complete with shoulder straps (left).

MAKERS' ADDRESSES

Alpenlite, 3891 N. Ventura Ave., Ventura CA 93001; **Eddie Bauer,** 15010 N.E. 36 St., Redmond WA 98052; **Coleman Co.,** 250 N. St. Francis, Wichita KS 67201; **Early Winters, Ltd.,** 110 Prefontaine Pl. S., Seattle WA 98104; **Moss Tent Works Co. Inc.,** Mt. Battie St., Camden ME 04843; **Sierra Designs,** 247 Fourth St., Oakland CA 94607; **Slumberjack,** 2103 Humboldt St., Los Angeles CA 90031; **Tekna,** 3549 Haven Ave., Menlo Park CA 94025; **The Yak Works Corp.,** 2030 Westlake Ave., Seattle WA 98121.

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Pocket motor home

–surprisingly roomy and diesel-powered, too

Winnebago's new class of front-drive RVs uses a French-made power train

By HERBERT SHULDINER
PHOTOS BY GREG SHARKO

The early-morning quiet outside my house was suddenly shattered as I turned the key to start Winnebago's new recreational vehicle, Centauri. The vehicle had been delivered from the company's Iowa factory, and the professional who drove it east was showing me how the van worked.

The Centauri, a spacious van-conversion-type vehicle, is one of a unique trio of new models Winnebago has introduced this season. The other two are motor-home versions of the same vehicle: Winnebago LeSharo and Itasca Phasar. All three are the first of a new class of fuel-efficient, compact RVs. They're built on a Winnebago chassis with a two-liter diesel and a front-drive power train adapted from Renault vans.

The reason for the noise, of course, was Centauri's diesel engine. And it's not only noisy on the outside—as we discovered during our tests. A group of PS editors test-drove Centauri for 2,000 miles through New York, Pennsylvania, and New England. Then, at Bridgehampton Race Circuit in New York, the vehicle was put through the same tests we perform on cars.

Handling and maneuverability of the new Winnebago are superb for a vehicle of this size. "The Centauri rides and handles like a family sedan," says PS automotive editor Jim Dunne, who put the Centauri through our handling tests. I found the same to be true on the open road and even when I had to parallel park the rig. Passing trucks and wind gusts, however, would push the vehicle around noticeably.

But the Centauri lacks sufficient power for really satisfactory performance. Its zero rating for acceleration (see accompanying table) resulted from a tortoise-paced 36.4 seconds from zero to 50 mph. (Bridgehampton doesn't have a straightaway long enough to permit accelerating the Centauri to reach 60 mph—the usual goal in this test.) On the open road this translates into unsatisfactory performance in hilly country. On many occasions I could not maintain 50 mph on moderate hills on the Connecticut Turnpike.

The engine operated at high rpm as I tried to maintain legal cruising speed. This made for noisy conditions in the cab of the vehicle. We measured 73 decibels when the Centauri was in fifth gear—only slightly noisier than standard sedans. But when I downshifted, the noise became truly annoying: 88 decibels in second gear (30 mph) and 83 decibels in third gear (50 mph). Riding up hills in third gear was an awfully noisy experience.

The Centauri doesn't quite live up to its billing as a 20+ mpg vehicle. PS fuel tests showed 28 mpg at 35 mph and 16 mpg at 55 mph. Over the nearly 2,000 miles that we drove the vehicle, fuel consumption was an observed 19 mpg—using a top-off system of measurement. Still, it's about the most fuel-efficient RV available.

Our test team concluded that the Centauri needs a turbocharger to give adequate performance. And sound insulation is a must. A company spokesman told PS that a noise-suppression consultant has been retained to develop a more effective noise-baffling system for later models. Also, Winnebago President Ronald Haugen says a turbo diesel will be available by late winter. In addition, a 2.2-liter gasoline engine will be introduced next summer.

Price of the Centauri is under $20,000; LeSharo and Phasar prices start at $23,000. PS

PS ratings—test report in a nutshell

The ratings are based on test results and measurements. Results should be read with the understanding that they reflect tests only on our sample vehicle. An excellent rating is 5 points; very good, 4; good, 3; fair, 2; poor, 1; very poor, 0.

Acceleration	0
Braking*	5
Handling	2
Maneuverability	3
Quietness	0
Ride comfort**	4

*From 50 mph
**Author's opinion

Observed fuel mileage

35 mph	28
55 mph	16

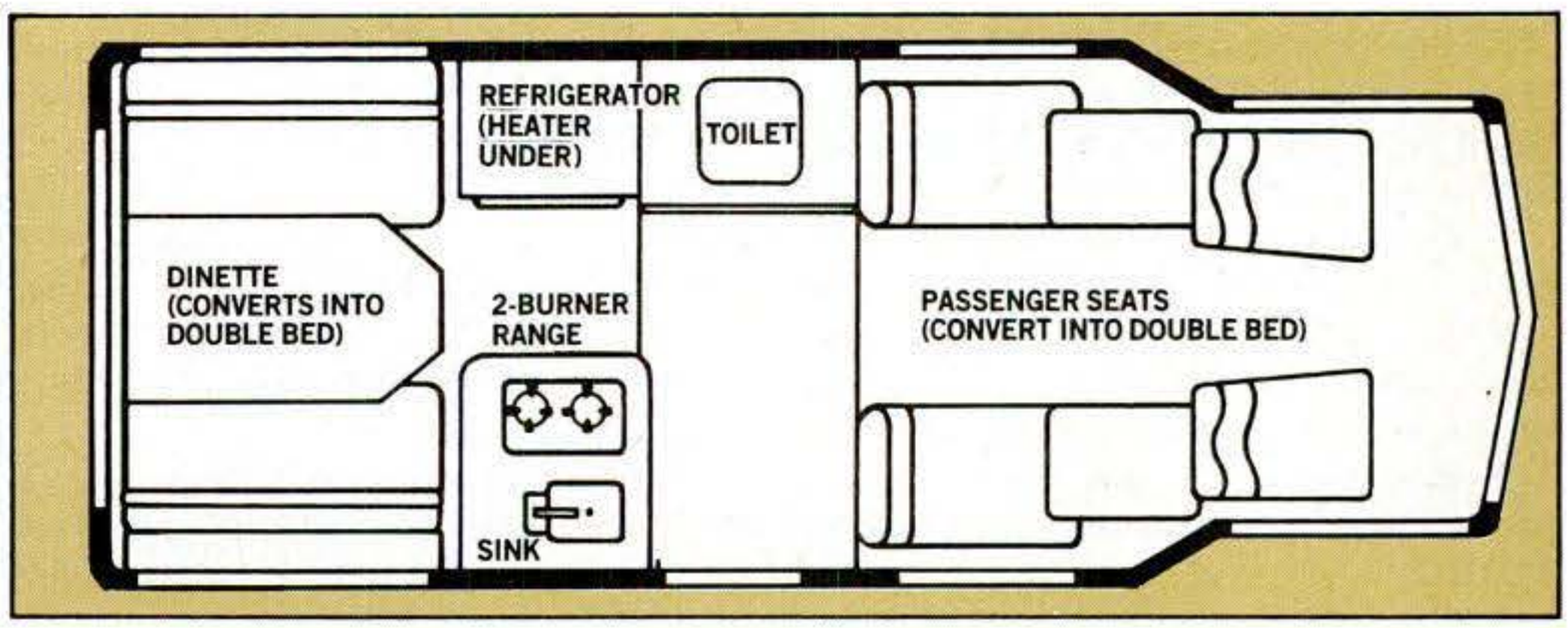
PS serviceability ratings

How easy is it to service this vehicle? To give you an approximation of how difficult it is for a typical person to perform various service operations, we examine the test vehicle. The numbers mean: 1, very difficult; 2, difficult; 3, average degree of difficulty; 4, easy; 5, very easy.

Checking fluid levels	
Battery	5
Master cylinder	4
Windshield washer	5
Engine oil	5
Coolant	1
Checking the engine	
Oil filter	4
Oil fill	4
Replacing hoses	
Upper radiator hose	3
Lower radiator hose	3
Heater hoses	2
Changing bulbs	
Headlights	3
Taillights	3
Front running lights	5
Front parking lights	3
Front directionals	3
Rear directionals	3
Rear running lights	5
Checking fuses	5
Spare-tire accessibility	5
Changing belts	2

TEST RESULTS	
Acceleration (sec.) 0–50 mph	36.4
Brake test (cool) 50–0 mph	
Stopping distance (ft.)	120
Pedal pressure (lbs.)	120
Brake test (hot) 45–0 mph	
Stopping distance (ft.)	98
Pedal pressure (lbs.)	60
Interior noise @ 60 mph (dBA)	73
Handling test (mph)	57
Maneuverability test (mph)	25.8

TEST CONDITIONS: Ambient temperature, 60°F; relative humidity, 85 percent; barometric pressure, 28.7 inches Hg



Stylish Winnebago Centauri (left) is a fuel-efficient RV with carlike handling features. Floor plan (right) of its motor-home sisters, LeSharo and Phasar, reveals a compact and efficient living arrangement for traveling. The new vans are nearly 20 feet long. Height and width are just over seven feet. Inside there's six feet of headroom at the center. The new Winnebagos weigh 5,830 pounds, including a load capacity of 1,700 pounds.

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'83 Corvette

Chevy redesigns an American classic

GM's sports car takes aim at the big-league performers

By JACK KEEBLER
PHOTOS BY GREG SHARKO

RIVERSIDE, CALIF.

"Load the engine up against the torque converter, but try not to spin the rear wheels," suggested the Chevy engineer in the passenger seat. I stepped on the brake and nudged the '83 Corvette's accelerator pedal down. Instantly, despite the tremendous bite of the Goodyear P255/50VR16 tires, I could hear the back ones spin, and the 3,117-pound car pivoted slowly to the left.

I reminded myself that the injection-equipped small-block 350 was developing over 200 horsepower and, more importantly, 290 ft.-lbs. of torque. Gently, I eased the pedal down and watched the revs climb on the green wave generated by the liquid-crystal tachometer.

I side-stepped the brake and floored the accelerator. At 60 mph I pushed the button on the stopwatch: 7.67 seconds. But performance is only one exciting aspect of the newly redesigned Corvette.

Boasts Bob Stempel, Chevrolet general manager: "This car is a clean sheet of paper." Here's a look at some of the new Corvette design features:

- Four-speed manual transmission with computer-controlled overdrive.
- Extensive use of high-strength steel, aluminum alloys, and fiberglass in the body-frame and suspension.
- Restyled body with a greatly improved aerodynamic drag coefficient of 0.34.
- Unidirectional tires that are designed to roll in only one direction for maximum traction and handling.

Two transmissions are available in Corvette. The automatic is last year's excellent four-speed. The news this year, though, is the four-speed manual gearbox. Packed into the tail is an overdrive unit. Inside it is a planetary gearset that provides a 0.67 overdrive in second, third, and fourth. An onboard computer measures the throttle position and several other engine functions, and automatically determines whether or not the overdrive should be activated.

In 1953, when fiberglass was chosen as the car's body-panel material, Corvette established its reputation as a design maverick. The tradition continues, as does the fiberglass body. This year the car has two structural backbones. One is an integral high-strength steel perimeter frame with torsional rigidity improved over the previous body-on-frame design. The second backbone is a triangulated "C" section beam bolted to the transmission's tail and the nose of the differential. The aluminum prop shaft runs through its center.

Front and rear suspensions are made almost entirely of high-strength aluminum. They also share an unusual fiberglass transverse leaf-spring configuration. All four wheels have ventilated disc brakes with new finned aluminum calipers.

Outside, Corvette has been completely revamped: 1.1 inches lower, 8.8 inches shorter, and two inches wider. Using Boeing's wind tunnels, GM engineers were able to reduce drag by 23.7 percent.

The designer-stylist's job was carried over into the engine compartment. The clamshell hood tips forward. Underneath, the position and even the color of every item, down to the spark-plug wires, were carefully planned with attention to aesthetics as well as access and function.

Under the "fast" 64-degree windshield is a flat-black dash with electronic instrumentation that winks to life with a twist of the key. Unfortunately, I found these flashing, dancing liquid-crystal displays difficult to read. Interpretation was further confounded by bright sunlight reflecting off the plastic facia. At speed, reading the gauges should take only a glance. But even sitting in the pit lane, the Corvette's dash display defied quick understanding.

Despite GM's claim of additional interior room, my five-foot-seven, 155-lb. frame found the Vette's insides confining and difficult to enter and exit. The foot corridor is narrow and short, and the bolsters on the electrically operated, multiple-adjustment bucket seats are extremely tall.

The design search for the new car's tires started five years ago. The Goodyear Eagle VR50, developed from the "natural path" Formula One racing rain tire, was the answer. [See "Supertires," PS, Nov. '82.] This new rubber and the taut suspension allowed me to go deep into corners at 70 mph that I wouldn't have attempted at 40 in most performance sedans.

This year, Corvette will retake its place as one of the best-handling road cars in the world. PS

Bulbous contours of old have been shaved onto the styling studio's floor. But Vette styling clues remain. Gills behind the front wheel housings, arched front fenders, and the resculptured but unmistakable nose are still there. Inside are an electronic LCD speedometer and tach flanked by digital-display readouts.

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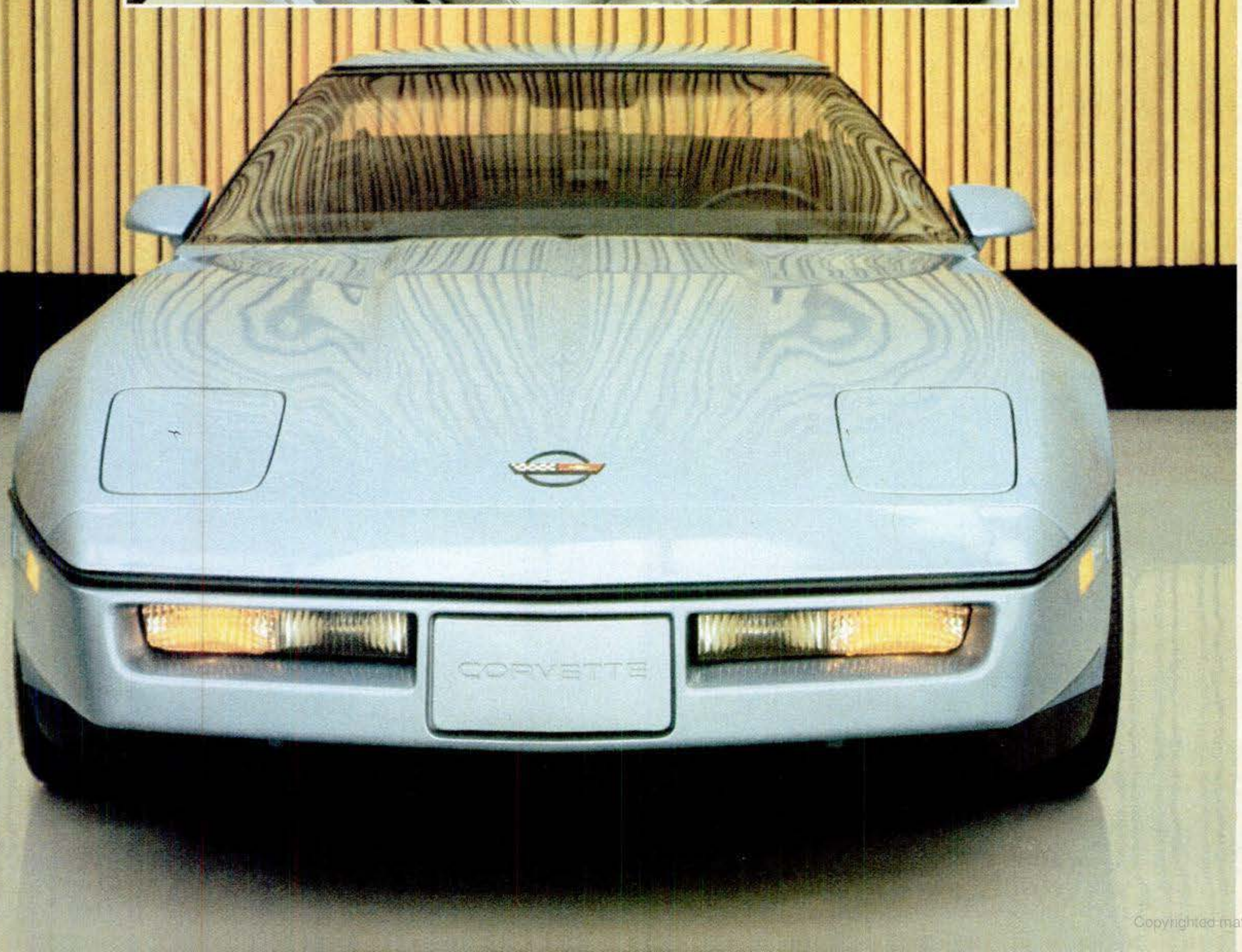

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Ford's front-drive challengers:
Tempo/Topaz

Swooping down the test track, trim, curvy Tempo (above) impressed the author. Cutaway reveals the engineering innovations: high-swirl engine, Quadralink suspension, wraparound doors, more. Topaz (four-door shown) is Tempo's twin. Tidy interior reflects tailoring as practical family car.

How do you get big-car feel in a mid-size package? Ask the engineers

By JIM DUNNE

Looking for a comeback from its slump of recent years, Ford Motor Co. will introduce two new front-wheel-drive, mid-size models this spring. Ford Tempo and Mercury Topaz, identical except for nameplates, will be built as two- and four-door sedans. They feature a host of engineering innovations, including a new four-cylinder engine, unique rear suspension, refined automatic transmission, highly aerodynamic body, and unusually quiet passenger compartment.

Top company officials expressed high hopes for the cars when they were unveiled at a Dearborn press preview. "Tempo will be a big line for us in the coming years," said Ford division general manager Lou Lataif. "It's planned to take 30 percent of Ford sales." Overall, the company hopes Tempo and Topaz will lead a Ford surge to a 20 percent share of the U.S. market (it has 17 percent now), President Don Peterson told me.

The cars will compete with GM's X and J models, Chrysler's K-cars, and the mid-size Japanese imports. In Ford's lineup, they fall between Escort/Lynx and LTD/Marquis, assuming the place of the old Fairmont. Tempo and Topaz are family-type cars, with emphasis on big-car ride and feel.

That image called for an engine that delivers maximum horsepower at relatively low engine speeds, just the opposite of most smaller engines that rely on high speed for their power. Ford engineers achieved the desired output curve from the new 2.3-liter four-cylinder HSC (High Swirl Combustion) engine—not to be confused with Ford's existing power plant of the same displacement—by equipping it with "fast burn" combustion chambers.

Fast burn means getting 90 percent of the air-fuel charge burned within a 15-degree turn of the crankshaft. This allows the engine to run smoothly at a fairly high compression ratio (9:1) and permits a high percentage of exhaust-gas recirculation without misfire.

Here's how it's done: First, the spark plug is set in the center of the combustion chamber so that the flame front has the shortest distance to travel to the far corners. That's the easy part. In addition, the intake-valve openings are half shrouded, forcing the charge to accelerate through the other half in a high-velocity swirl. Thus the charge fills the chamber more quickly than in a conventional engine. The HSC design is partially derived from Ford's defunct PROCO engine-development project.

Torque of the engine is estimated at 125 ft.-lbs. at 2,700 rpm. Horsepower is 90 at 4,700 rpm. It is the only engine available for Tempo/Topaz this year, but the company plans a 2.5-liter size for next year, according to Lataif. "We're not looking at a V6 at all," he added.

Tempo/Topaz buyers can choose four- or five-speed-overdrive manual transmissions, but the company expects to sell as many as 80 percent of the cars with its ATX-type automatic. It has three speeds, but high-gear power is 93 percent mechanically transmitted, leaving just seven percent to go through the torque converter. Slippage is almost nil; that's reflected in the EPA city-highway mileage estimates of 25-36 for the automatic. The manuals are expected to be rated at 29-43.

Good connections

Extra care was taken to make the engine-transmission hookup a solid one. A cast-aluminum oil pan ("only the third in the industry," according to Tempo/Topaz chief development engineer Ed Cascardo) cuts down on bending and makes a more rigid drive train. That improvement allowed other changes, including a 50 percent reduction in the taper of the gears from that formerly needed to take up bending slack, and the elimination of a shim in the gear case that was needed to hold the gears close when bending took place. Another change was increasing the gear-contact ratio (average number of gears in full contact at any time) to a robust 2.75. This all but eliminates gear-ringing noises.

I test-drove some prototypes during the Dearborn preview, and the transmission impressed me as one of the smoothest I've driven in a small car. There is virtually no discernible lurch when shifting to drive from neutral and little vibration or noticeable engine-speed change. Shifts at speed are so subtle as to be unremarkable. But if you floorboard the accelerator, you will feel some lag in gear change and some overrevving of the engine—typical features of an automatic set up for smoothness.

Certainly the most immediately noticeable feature of the new Fords is their rounded shape. Whether or not you like it, Ford is committed to that kind of body for its cars of the future. Details of Tempo's exterior that Ford stylists point to as aerodynamically inspired include the wedged body profile, center-mounted front license plate, flush bumper end caps, sloped grille, and "wind-tuned" hood edge.

The doors also took extra time in the wind tunnel. They wrap up into the roof with an exterior panel that extends at least three inches past the rubber seal at the top. This permitted elimination of the drip rail, a notorious wind catcher. The extra extension of the door catches water that runs into the door-roof seam and diverts it away from the side windows.

In total, Ford claims a 0.36 drag coefficient for the two-door, 0.37 for the four-door. At 50 mph, the two-door requires just six horsepower to overcome wind drag.

Two other engineering elements help give the cars the desired big-car feel: noise control and soft ride. "We use 45 pounds of sound-control materials in the base car," Cascardo told me. "In the Escort we have only 23 pounds. Most of the added material is in the cowl and front floor, critical areas since most of the noise comes from the engine and front tires." The improvements resulted in a three- to four-point reduction in decibels, Cascardo said.

Higher-price models include a premium sound-control package with an additional 10 pounds of sound-absorbing material, cutting a significant two or three more decibels. On the test track, even though I didn't have a decibel meter to check the results, I was impressed with the cars' quietness. Engine noise was low, gear noise from the drive train was virtually nonexistent, and suspension shock and vibration were subdued.

The key to the Tempo/Topaz soft ride is the new Quadralink rear suspension, which Cascardo called "the first fully. independent MacPherson strut rear suspension designed and manufactured in the United States." Two longitudinal tie rods and four parallel transverse suspension arms (a pair to each side) hold the wheels in place. Springs are tilted slightly inward to match the direction of wheel movement. Their travel is a long 8.5 inches, matching that of the big Fords and Mercurys.

There is also a good amount of rubber at the connection points in the suspension. This insulation reduces shock, but it also softens the connection between the chassis and body, reducing handling response. In my test drives, however, I could not determine how far Ford went in trading off handling for ride. PS

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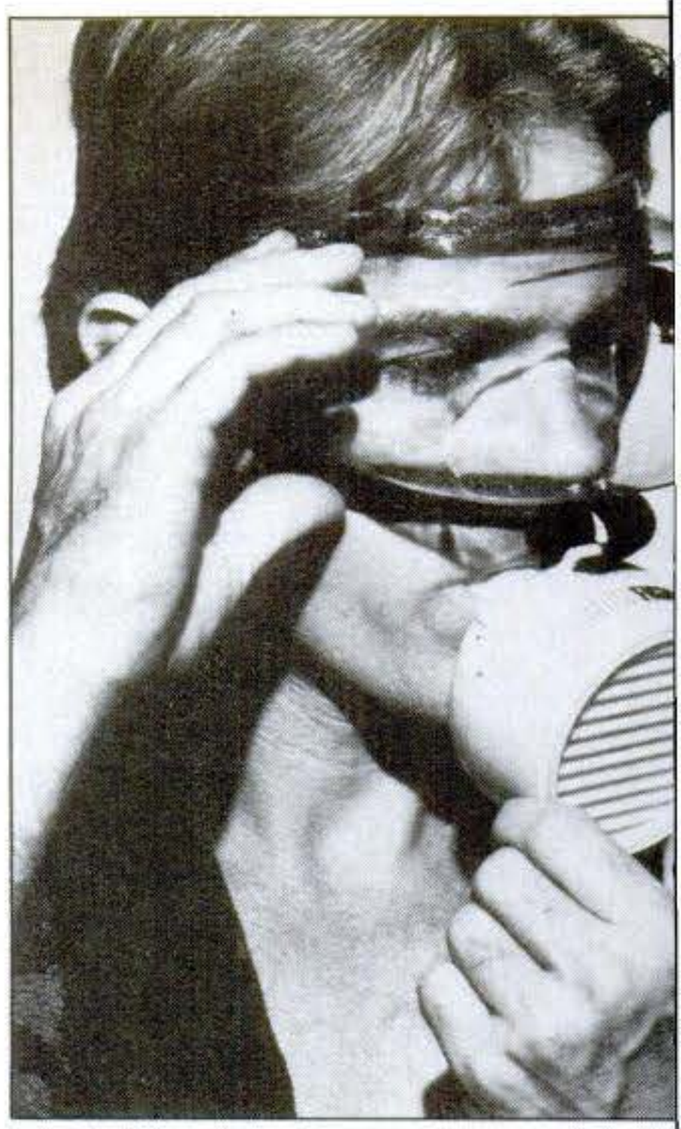
What's New

A PICTURE ROUNDUP OF NEW PRODUCTS AND DEVELOPMENTS

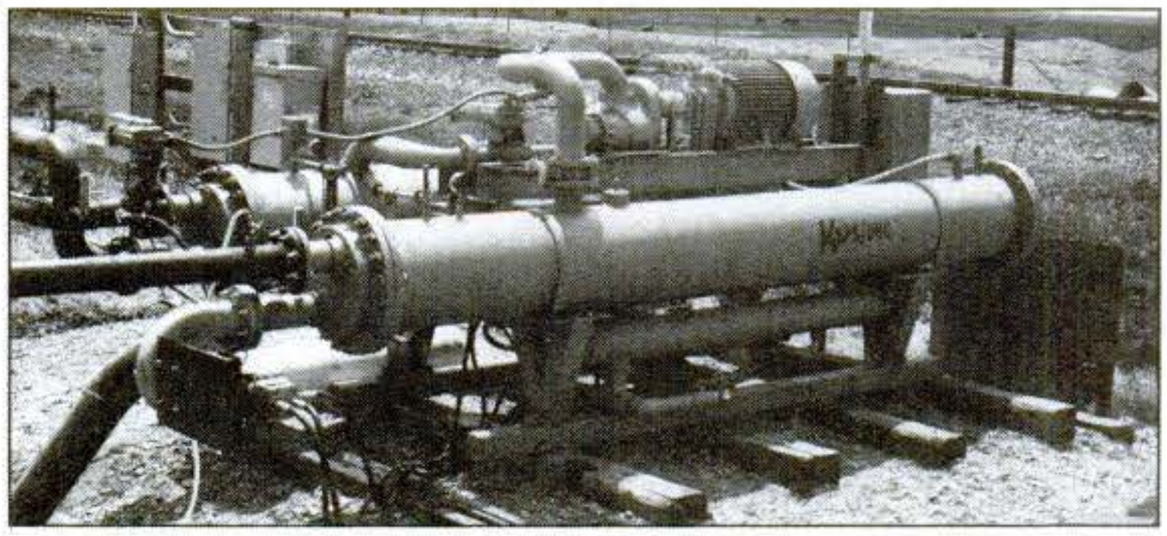


Escape mask

SmokeFighter helps you escape from fires by filtering air and providing clear vision. The mask blocks hydrocarbons and smoke particles for at least 15 minutes, according to Dolby ESM, Inc. (707 Jr. Terrace, Chicago, Ill. 60613). Price: under $40.

Tilting trike

All three wheels on the AR-3 recumbent-type tricycle tilt when you steer into corners. That lets you hug the road, while inclined pedaling boosts efficiency 23 to 55 percent, says developer Interstate Central (Madison, Wis.).



Hot-water power

A 30-kW Rankine-cycle generator taps geothermal energy from a 176-degree-F hot spring near Lakeview, Ore. The manufacturer, SPS Inc. (Miami, Fla.), has machines that put out up to 1,000 kW from industrial waste heat or solar sources, too.

Close-focus lens

For close-up hobbyist work or the partially sighted, this 4×12 monocular adjusts from infinity down to seven inches. The field of view is 12.5 degrees. It's available hand-held or for spectacle mounting from Sam Walters, 412 W. Sixth St., Los Angeles, Calif. 90014.

Mini notchback

Corsa, a mini economy car from Opel, GM's German subsidiary, comes as this notchback or a hatchback design. The 11.9-ft. sedan has a 70-hp OHC engine and gets 50 mpg at 56 mph and 27 mpg in cities, says Opel. The European-market car has a large 15-cu.-ft. trunk.

2+2 convertible

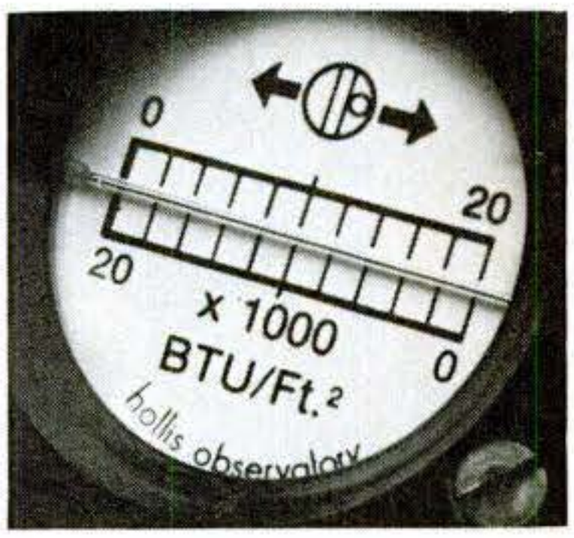
Based on the standard 911SC, the Cabriolet is Porsche's first convertible since 1965. 2+2 seating—with cramped rear seats—is retained. A three-liter OHC 172-hp engine can push the $30,000 911SC to 140 mph. EPA ratings: 17 mpg in the city, 27 mpg on the highway.

Target tracker

Seen any used 707 jetliners? The Air Force is considering equipping old commercial carriers with complex electronics gear to track vehicles and map terrain. Artist's concept shows a 707 relaying data to attacking ground and air units. Project is dubbed Pave Mover.

Electric city car

A three-seat, battery-powered city car has a driving range of 36 miles in traffic (48 miles at constant speed), says its maker, Gemini (Turin, Italy). A six-kW motor gives top speed of 40 mph. Doors on a closed version fold horizontally over the roof gaps.

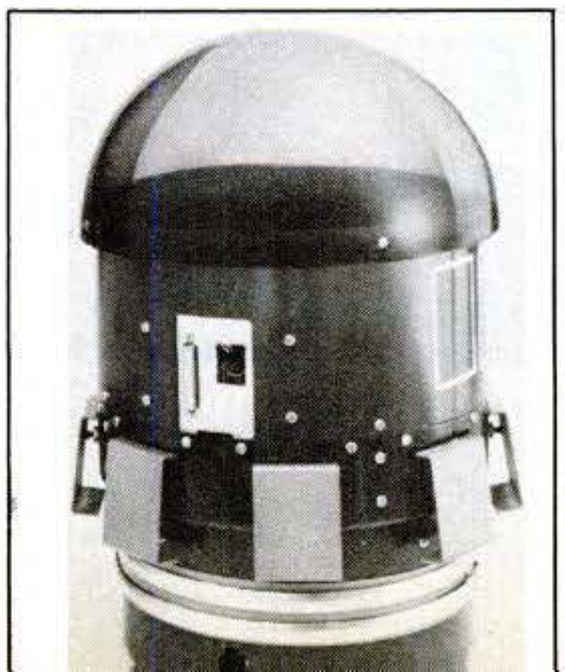


Solar meter

How much solar energy falls on a building site, greenhouse, solar-cell array, or crop? The TR-224 Insolometer accumulates readings over various periods, with three types of scale readings. Price: $99.50. Hollis Geosystems Corp., One Pine St., Nashua, N.H. 03060.

12-volt halogens

Tiny 12-volt Precise display lamps are cooler, whiter, and brighter and have lower wattage than conventional 120-volt incandescent lamps, says GE. The halogen bulbs, for architectural and display lighting, concentrate more light where it's needed to conserve energy.



Smart robot

RB5X, a 13-by-21-inch robot for experimenters, has a built-in microcomputer, tactile sensors, and programming so it can learn not to bump into objects. Price: $1,195 with arm, voice, and radio options. RB Robot Corp., 14618 W. Sixth Ave., Golden, Colo. 80401.

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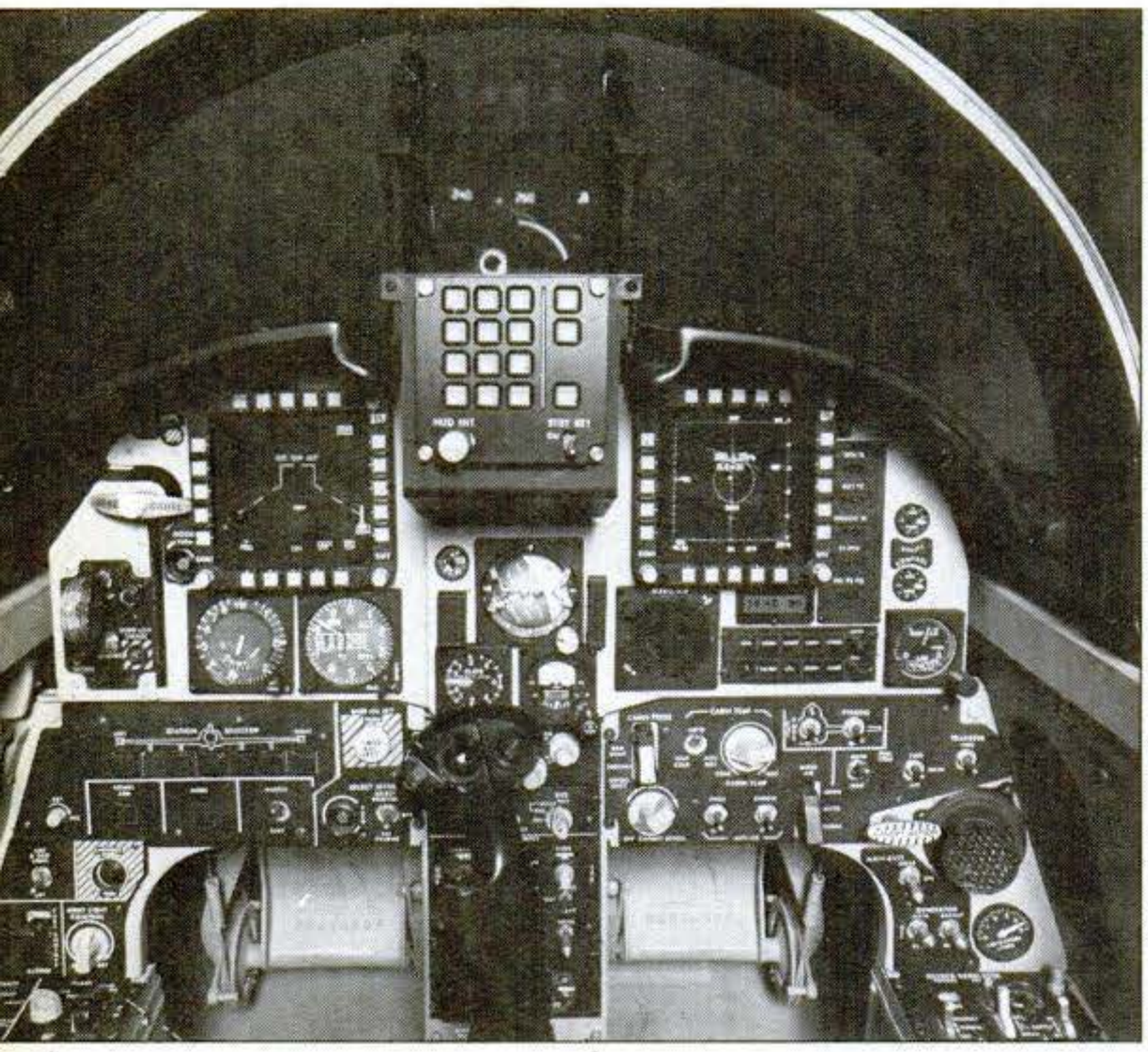
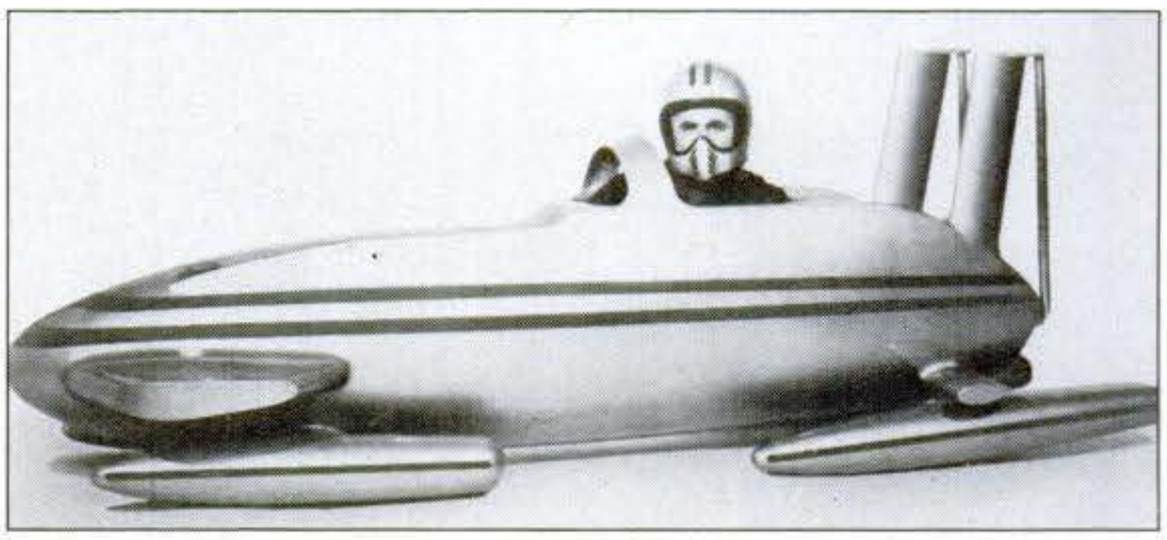
What's New

Office electric

The Juki Sierra electric typewriter has an 88-character keyboard and a snap-in, corrective ribbon cartridge. The Japanese-made machine can use all IBM Selectric ball typing elements, says Juki (20437 S. Western Ave., Torrance, Calif. 90501). The $495 machine weighs 21 lbs.





Simple cockpit

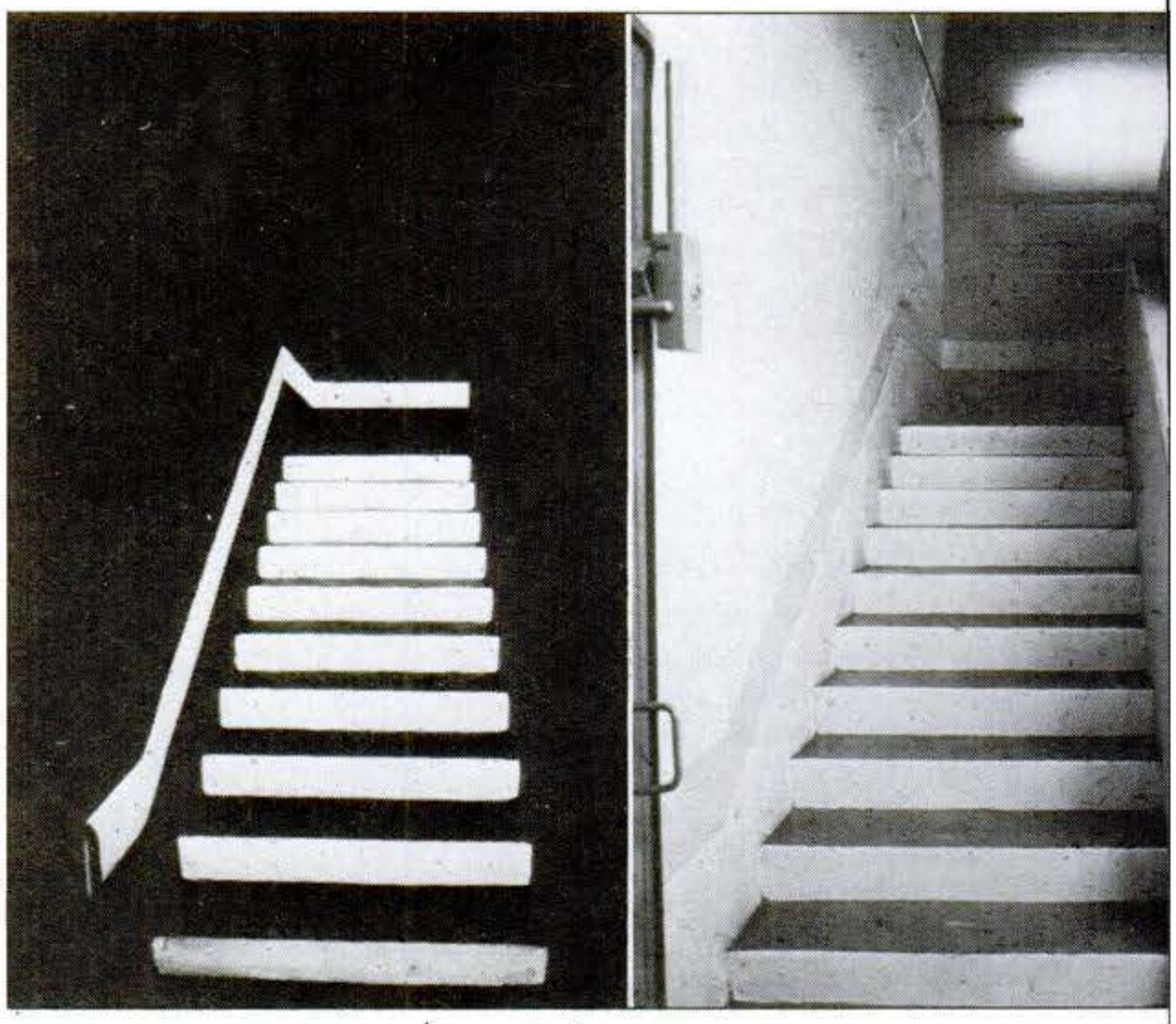
It looks complex—but the Tigershark's cockpit simplifies the fighter pilot's job, says Northrop Corp. In combat, a clear screen mounted on the windshield displays weapon and flight data. Other vital data show up on the screens flanking the top-mounted keyboard.

Better bobsled

Wind-tunnel tests helped shape this blunt-nosed sled. Its Kevlar-reinforced body is lighter yet tougher than other Olympic-class sleds, claims Gold Medal Bobsleds, Douglaston, N.Y. Special steel runners are designed to reduce friction drag, the maker says.

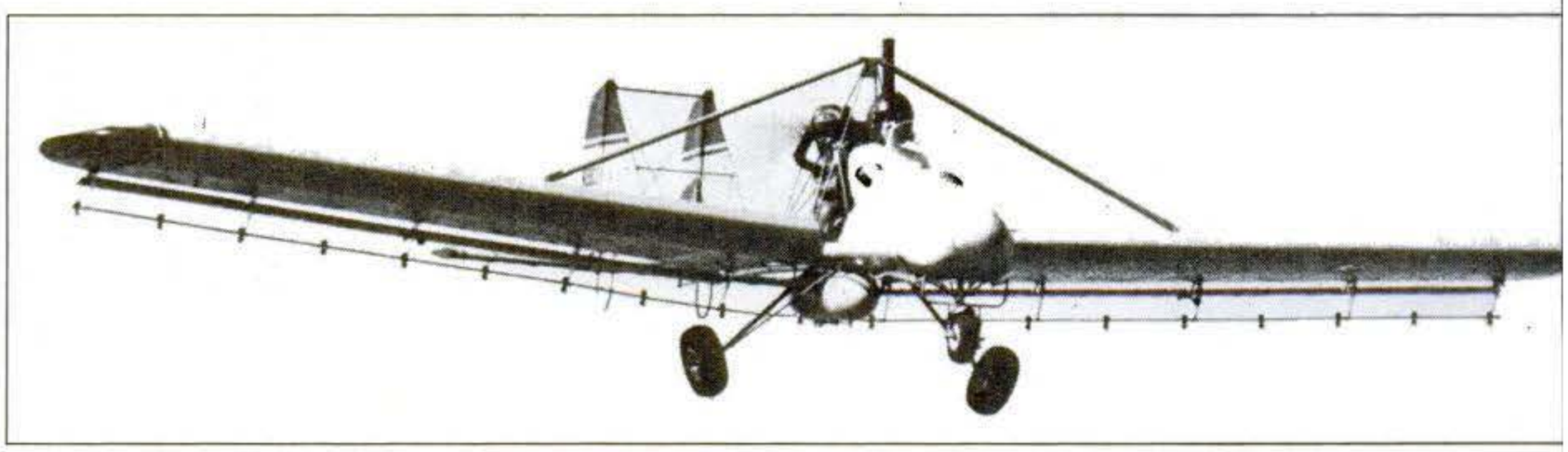
Backpack computer

Geologists can store field data in this portable computer's 16K memory. The backpack unit weighs 4.4 lbs. with batteries, and the keyboard has extra-large push buttons for use with gloves. Sweden's Geological Survey designed the Geomac computer.



Safety paint

In darkness (right) the stairs glow green. Flip the light switch (far right), and the lemon-yellow paint on risers and wall absorbs light, storing it for emergency use. The pigments in Aqualux-Safelight are radiation-free, says A.D.S. (132 Washington Blvd., Laurel, Md. 20810).



Simpler cockpit

Open-cockpit flying is no fun in winter. So Mitchell Aircraft (Porterville, Calif. 93257) has added a fiberglass enclosure to the ultralight P-38's cockpit. A Lexan windshield further protects the pilot. The whole unit weighs just eight lbs. and increases speed by 10 percent, says Mitchell.

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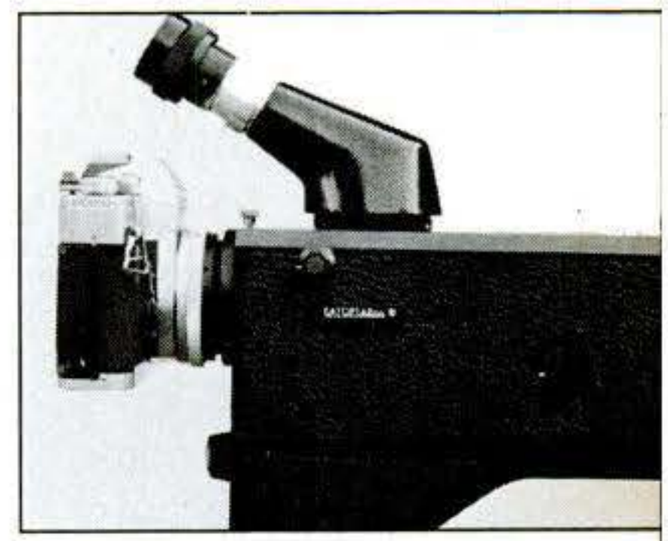
What's New IN PHOTOGRAPHY

BY E. H. ORTNER

Easy-access bag

Want to get at your extra lenses fast? Four zippered, individual compartments at the front of the Palisades SLR bag give you instant access. There's also a top opening, plus two-inch-deep end pockets. The nylon bag is $100 from Kalt Corp., Box 511, Santa Monica, Calif. 90406.



All-mirror 500

The unique all-mirror Katoptaron 500-mm lens [PS, Aug. '80] now comes in a new model, the TS 500 MV. It offers optional monocular or binocular viewing tubes that give up to 40× magnification. Importer: H & R Optical Systems, 971 Arapahoe Ave., Boulder, Colo. 80302.

System flash: one body, three heads

You can choose your head with Vivitar's 4600 flash system: a standard head with vertical and horizontal bounce capability, delivering a guide number of 100 with ASA 100 film; a motorized zoom head that automatically matches beam coverage to lens, from a wide-angle 28 mm to a tele 105; and a bare-bulb head to simulate the coverage of an incandescent bulb. A module adapts the flash to the dedicated electronics of most major 35-mm SLRs, and a Vari-Slave module (above, left) offers cordless slave operation. Controls (above, right) set lens focal length and any of three f-stop ranges. Body price (list): $195.

Motorized 120

Build a motor drive into the new 2¼-by-2¼ Bronica SQ-A, and you have the even newer SQ-Am. Options include an auto-exposure prism finder, Polaroid back, even a 35-mm back. Body price (list): $1,035. Distributor: GMI Photographic, 1776 New Hwy., Farmingdale, N.Y. 11735.

Marine housing

You can shoot underwater—down to 100 feet—if you add a Ricoh marine housing to a Ricoh AD-1 or A-2 35-mm automatic camera. There's an oversize ring for focusing, a large sports finder for viewing, an optical-quality glass port to shoot through. List price: $162. A-2 camera: $203.

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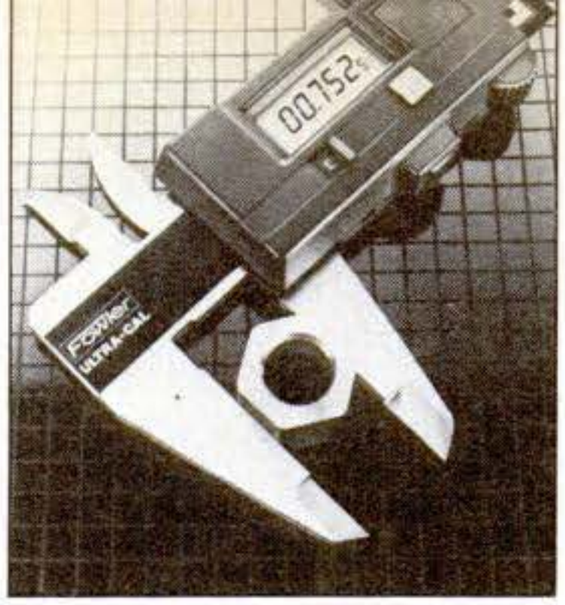
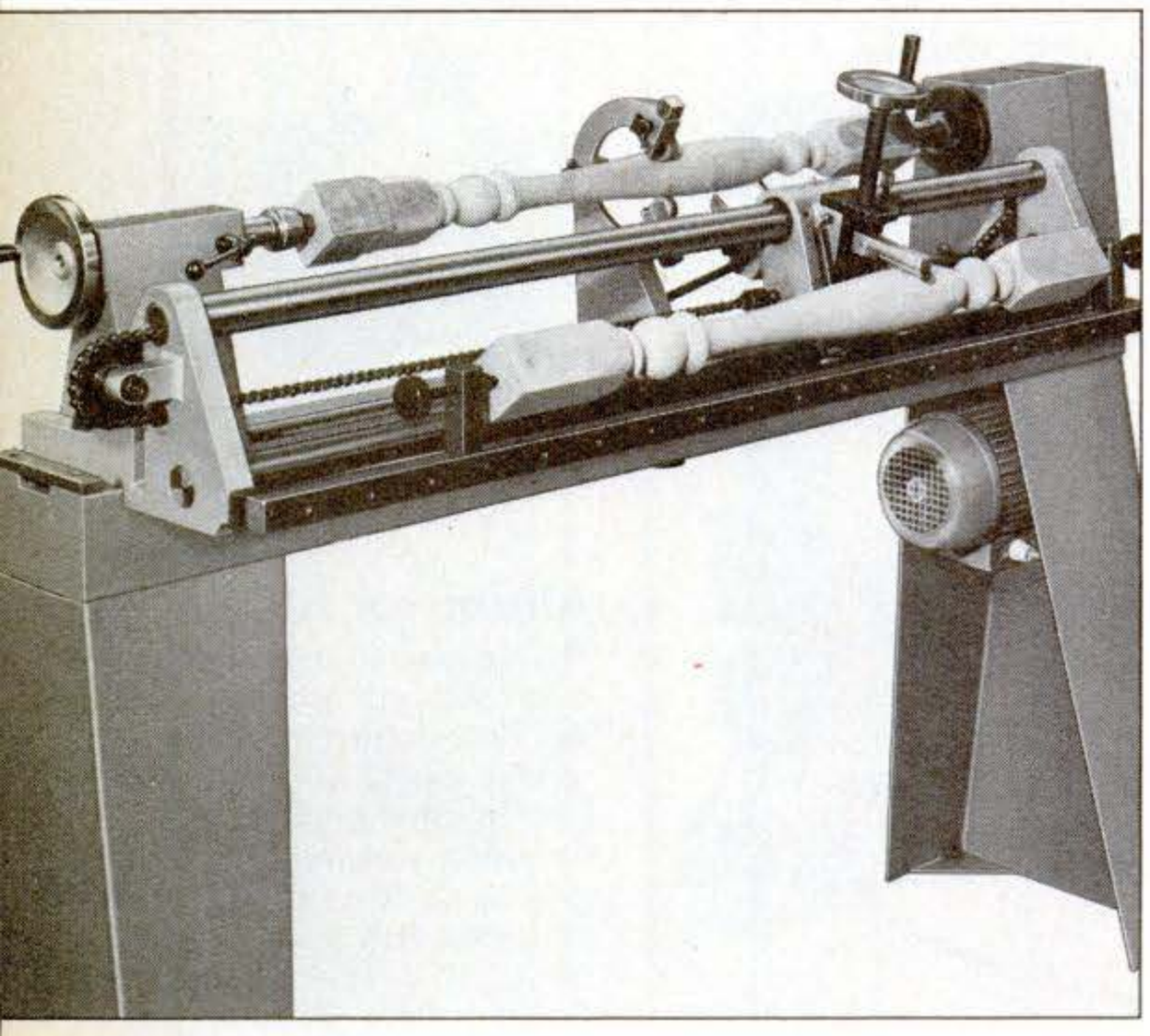
What's New IN TOOLS

BY V. ELAINE SMAY



Electronic caliper

Swiss-made Ultra-Cal takes inside, outside, and depth measurements, precise to 0.0005 inch, and displays the result in liquid-crystal digits. Touch a button and it converts to metric. H.C. Fastener Co., Box P, Alvarado, Tex. 76009; $199.50 (with batteries).

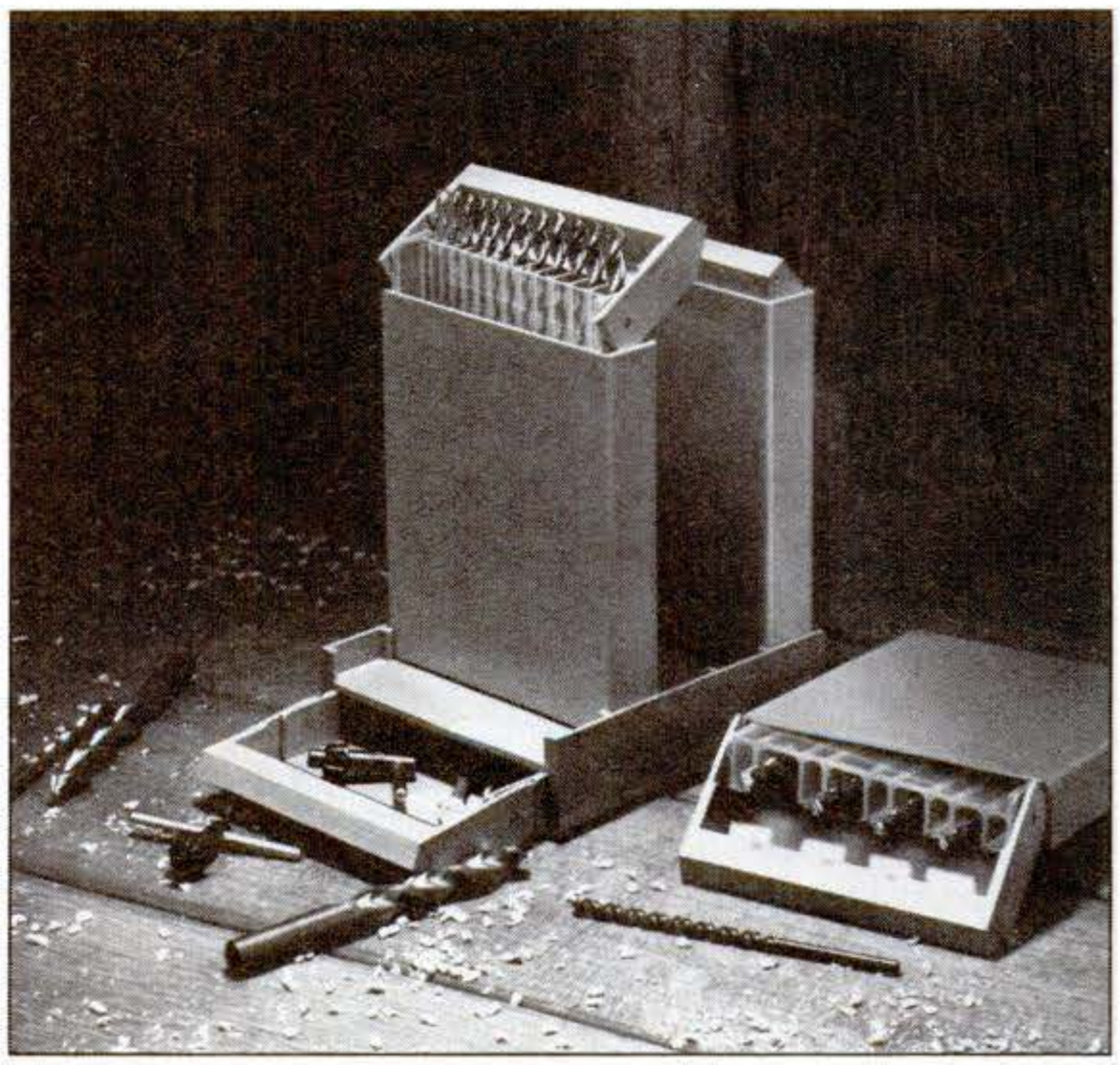


Performance lathe

The Hegner HDB 200 wood-turning lathe is designed for simplicity, quality, and precision, says the maker. Capacity: 39⅜ by 7⅞ in. Price: $1,595. It's shown with a duplicating attachment, LKH 950 ($995). Advanced Machinery Imports Ltd., Box 5285, Wilmington, Del. 19808.

Solder to go

Tuck a pack of Emergency Solder in your pocket and you can make quick repairs far from your soldering iron, says Multicore Solders (Cantiague Rock Rd., Westbury, N.Y. 11590). These small solder strips (with flux built in) melt in the flame of a match or candle, cost 99¢ a pack.



Split bits

You'll drill faster, with less feed pressure and easier centering, when you chuck an X-360 bit in your drill, says Credo (2765 National Way, Woodburn, Ore. 97071). The secret: The bits have split points. Basic 13-bit set with storage base (it holds five sets) is $16.

Reinvented bob

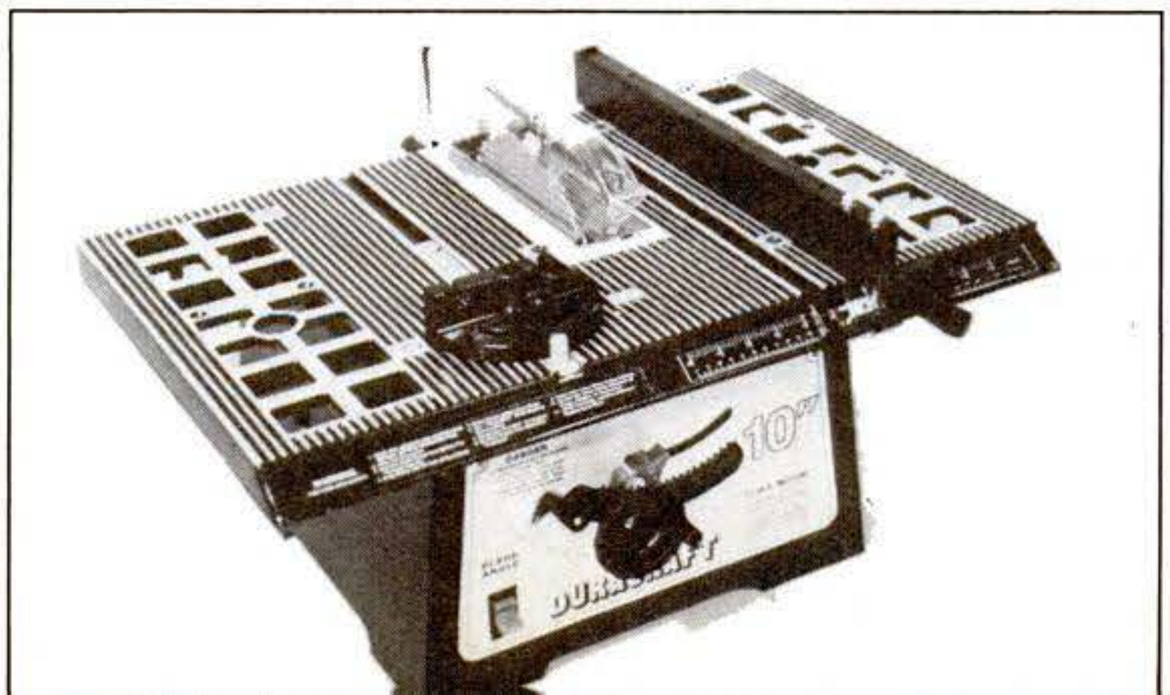
Internal radial pointers make it easy to mark the exact center below a drop line with the Circular Plumb Bob, says Stanley Tools Ltd. (Woodside, Sheffield S3 9PD, England). For working flush against a wall, you pivot the ring on its wire support; a rim pointer marks the spot.

Agile mower

They turn square corners, trim closely, and maneuver around obstacles, says Dixon Ind. Inc. (Box 494, Coffeyville, Kan. 67337) of its Zero Turning Radius mowers. Latest in the series: the ZTR 425. Its 42-in. mowing deck trims from left or right, reducing backtracking.

Big-blade portable

This bench-style table saw takes a 10-in. blade and gives the versatility and precision of a stationary saw, says Duracraft (19411 Londelius, Northridge, Calif. 91324). It has a 1½-hp motor and lockable on-off switch, and adjusts for angle cuts up to 45 deg. Price: $160.



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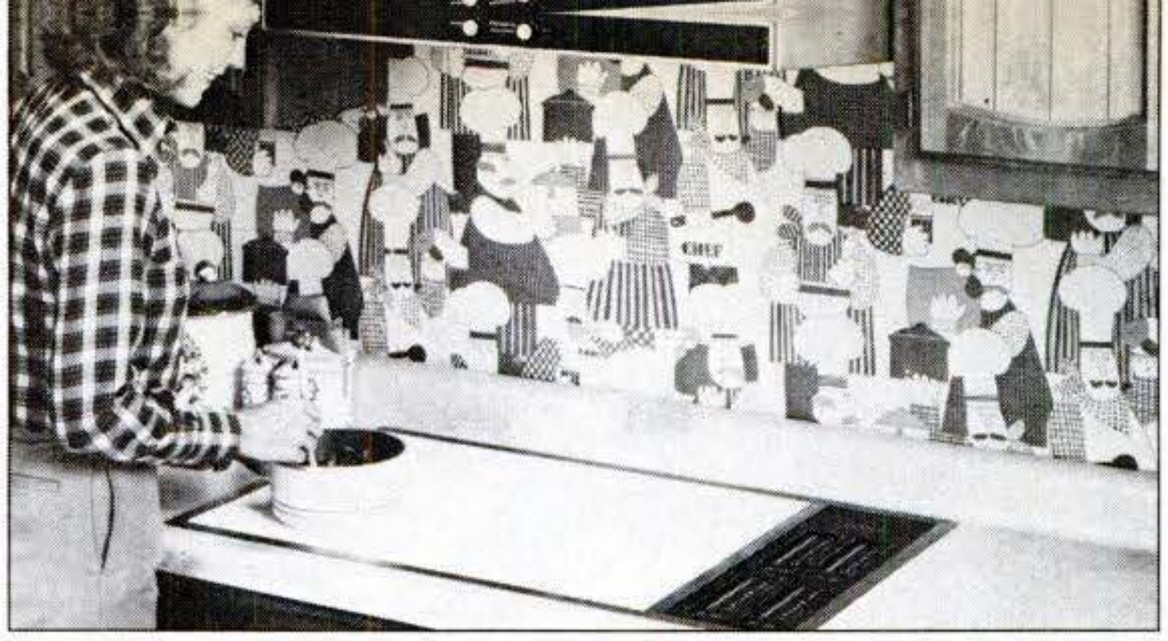
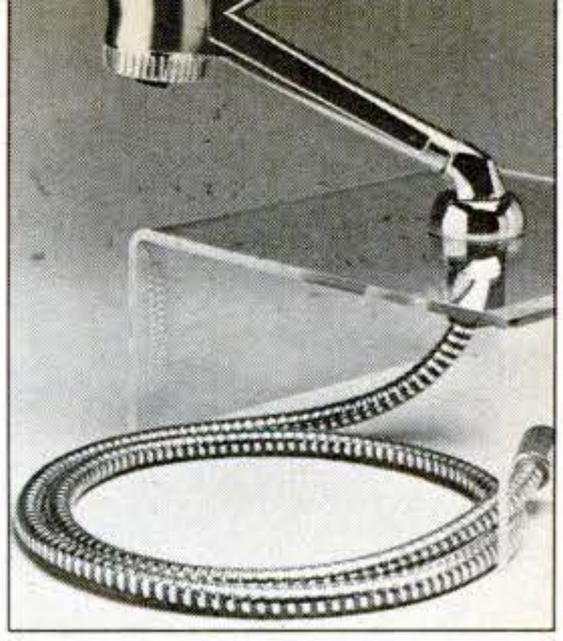
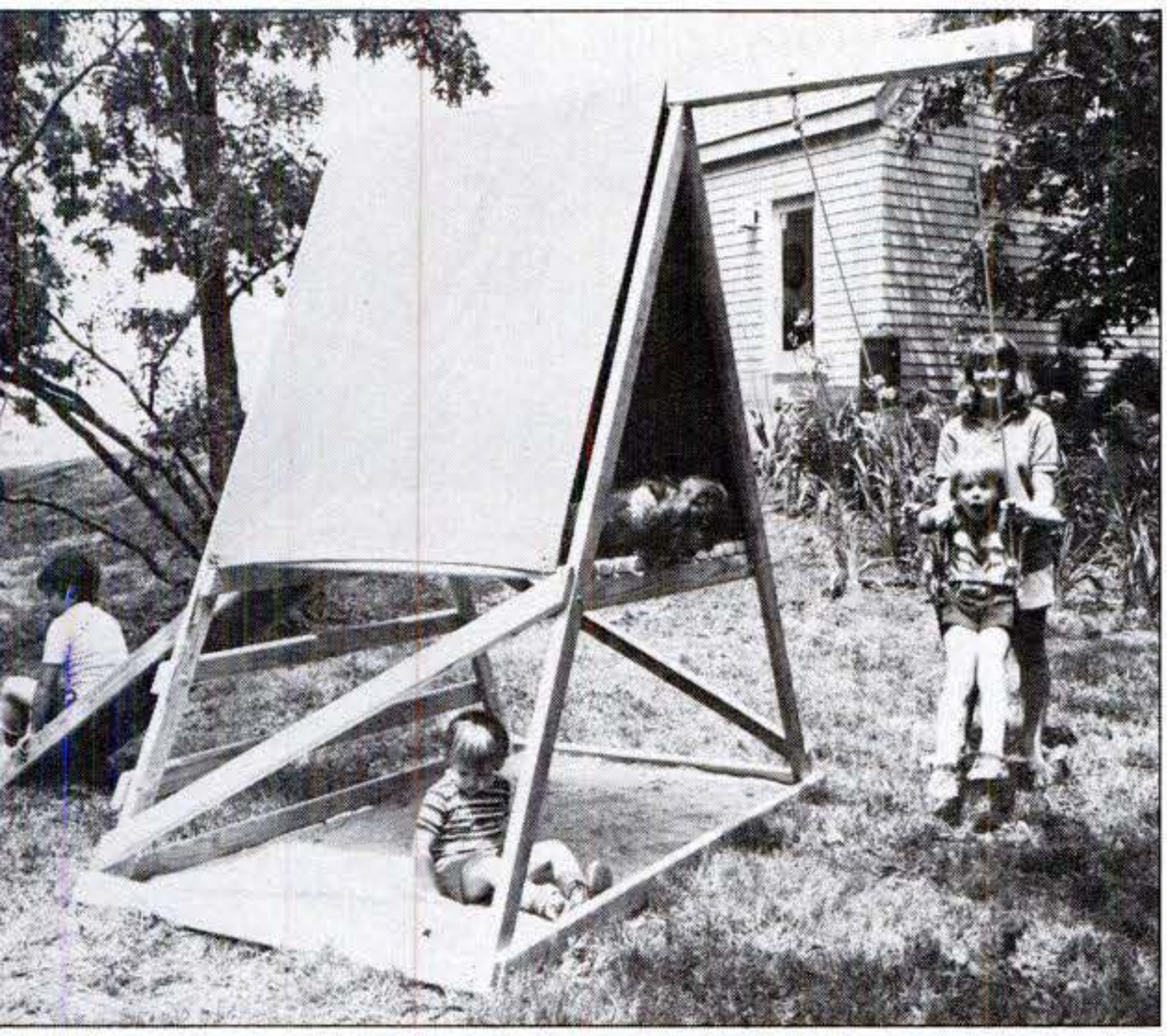
What's New
IN HOME IMPROVEMENT

BY SUSAN RENNER-SMITH







Magnetic stove

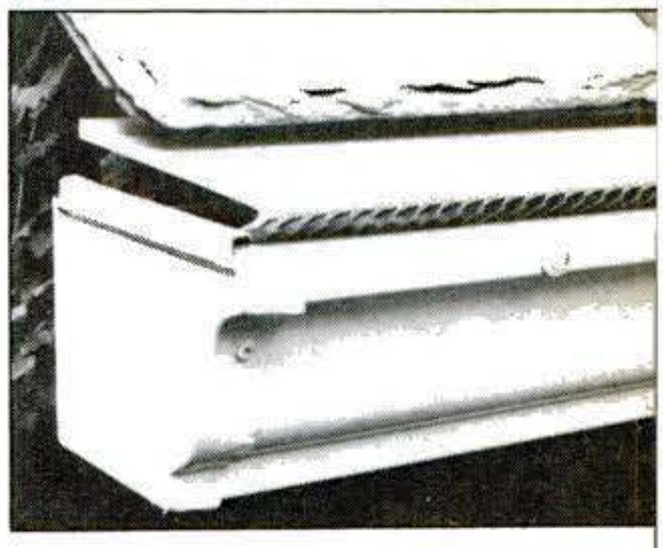
Only the pots get hot when you cook with the Sears induction cook top. The ceramic top conceals four electromagnetic coils that induce heat in metal pans. The $1,000 unit cooks food faster and uses less energy than gas or electric cook tops, says Sears.

Spa shower

Sybarites with sunken tubs may also desire a shower. But what if there's no wall nearby to hang one on? Ondine's shower mounts on the tub surround, with the hose hidden below. Version shown is $125. Ondine, 427 N. Baldwin Park Blvd., City of Industry, Calif. 91746.

Self-clean gutter

A covered gutter won't catch leaves, says Ibex Mfg. (Box 188, Centuck Station, Yonkers, N.Y. 10710). Water flows down over the cover's bent edge and into the gutter, the maker claims, while leaves and other debris go over the edge. Clog-Pruf gutter cover costs 66¢ a foot.

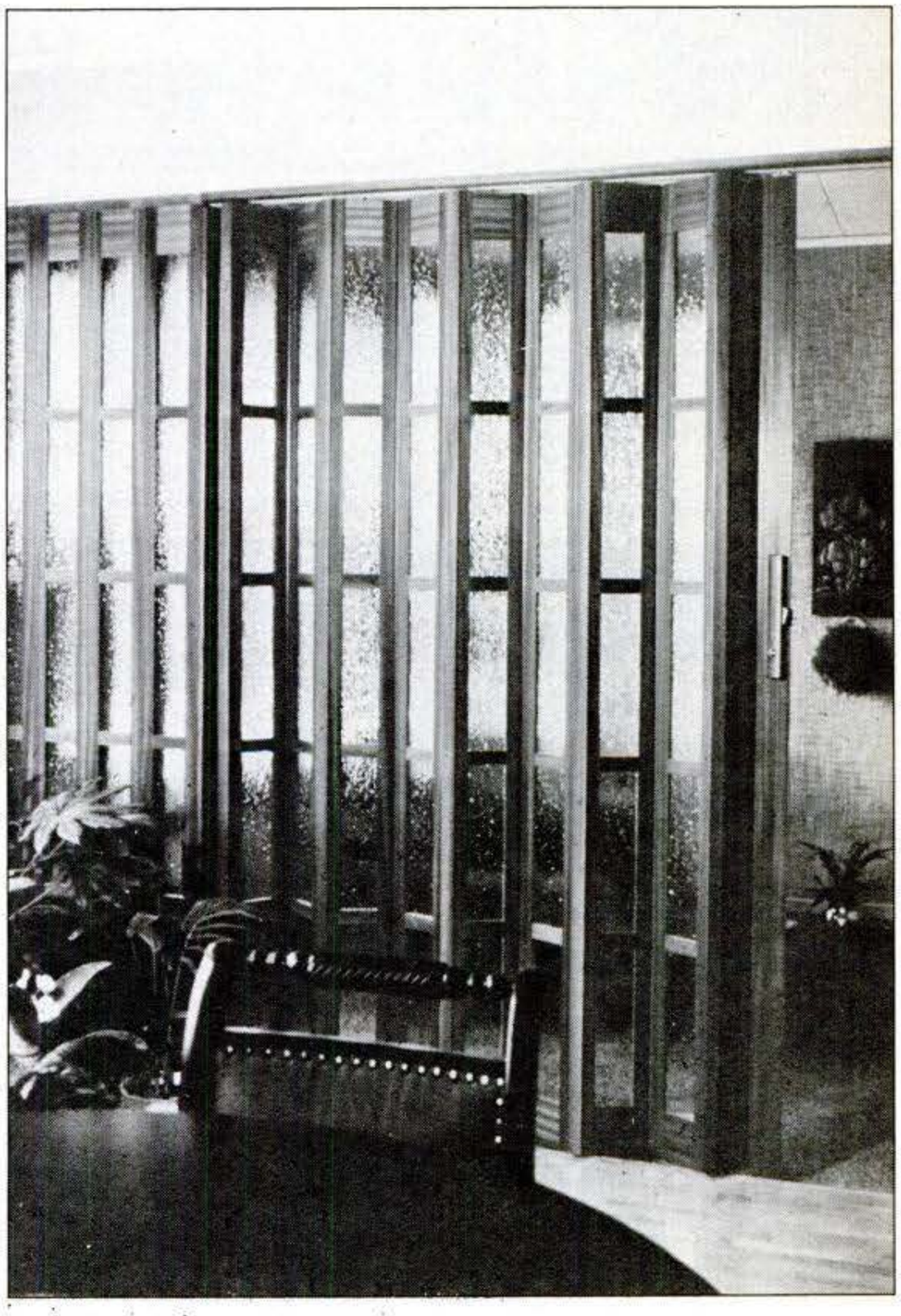


Heirloom swing set

Your toddler could pass this swing set on to his child. Made of pressure-treated wood, the Environment 1000 has a 40-year warranty against rot and decay. The unit shown costs $445. Wooden Environments (1890 Evergreen Ave., Speonk, N.Y. 11972) makes it.

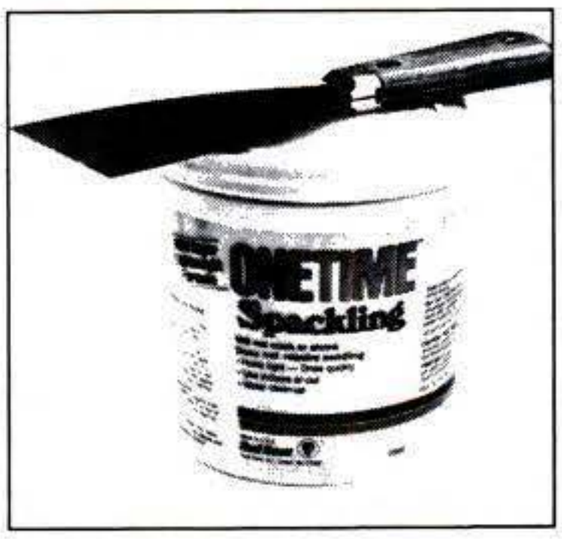
Folding doors

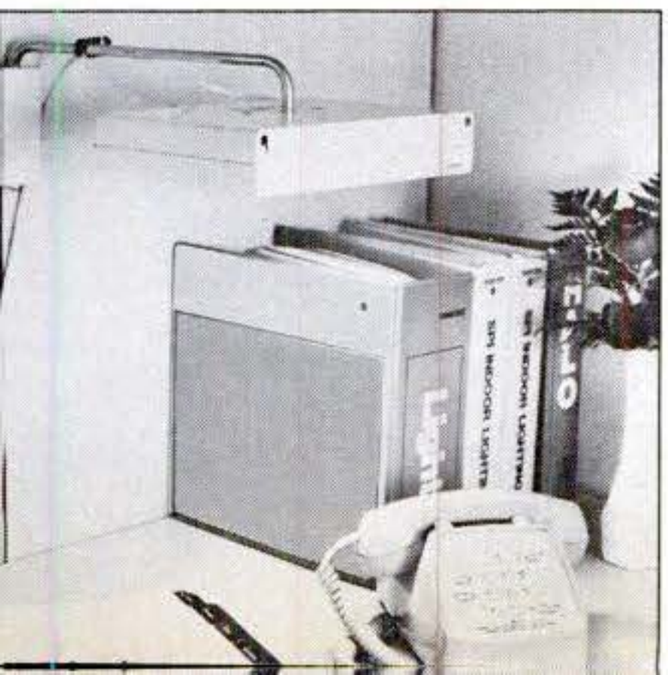
Conceal cluttered work areas without blocking off light. The Woodlite folding door has acrylic inserts set in frames of oak or mahogany veneer. Unique spring hinges keep door panels spread open evenly, says Rolscreen (100 Main St., Pella, Iowa). Price depends on width.



Super-spackle

Spread it on—and when it dries, you're ready to paint, says Red Devil. The new spackling compound will not sag, shrink, or crack—nor does a Onetime spackle patch need sanding before painting, the maker claims. It's $5 a quart.





Reading lamp

No glare, no shadows, no eyestrain—that's the claim made for the STC-30 Task Light. Its U-shaped 14-watt fluorescent lamp with an asymmetric reflector delivers more usable light to the work area, says Halo Lighting (400 Busse Rd., Elk Grove Village, Ill. 60007). The wall-mounted version is $48.

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What's New IN ELECTRONICS

BY WILLIAM J. HAWKINS

Smart switcher

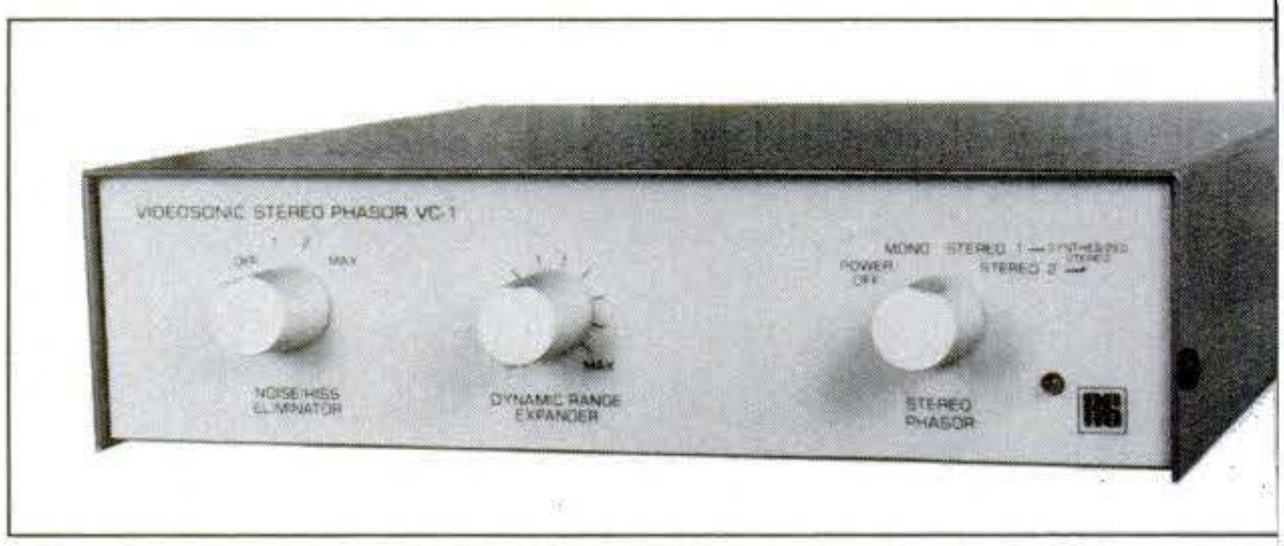
Attach your audio-video system to this switcher, and a microprocessor takes over: You program it to connect any of the switcher's five video and audio (stereo) inputs to any of six outputs. Made by Viditek, 9555 Owensmouth Ave., #14, Chatsworth, Calif., it's $799.

Note printer

"Play it again, Sam"? You can if you use the Yamaha MP-1 Portasound keyboard. Its attached printer "draws" (using a ball-point-pen stylus) the score you compose on 2.5-inch-wide paper. The song is held in the Portasound's memory until you're ready for a printout. $1,000.

Tape editor

If you own a Panasonic PV-5000 portable video-cassette deck, you can add this 13-function remote controller with digital search. But if you own two VCRs, the clever box also becomes an editor: Error-free insertions or dubs can be made from one tape to another. PV-R500 is $200.



Back-seat control

There's only one thing wrong with a high-performance in-dash car music system—it's in the dash. With the Fujitsu Ten, however, back-seat drivers also have a say in what is played: The entire system runs by infrared remote control. Availability and price are not yet set for the U.S.

Hi-fi TV sound

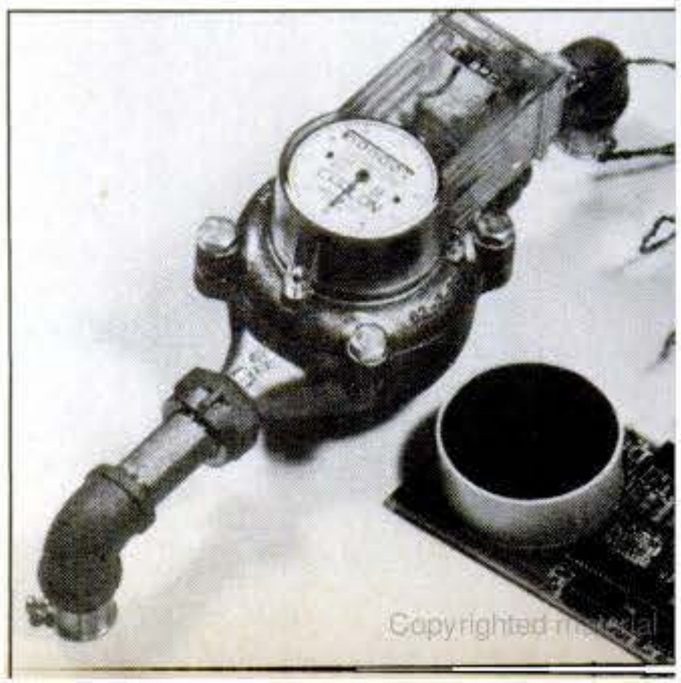
Connect the VC-1 between your TV and hi-fi system. Result: expanded audio levels, reduced noise and hiss, and, according to RG Dynamics (6440 N. Ridgeway Ave., Lincolnwood, Ill. 60645), synthesized stereo sound. It's $199.

AM/FM/basketball

Personal portable stereos are for people on the go. Sanyo RP77 is for people who already got there: Besides the AM/FM radio, it has a built-in LCD arcade-type basketball game to keep you busy. There are sound effects and two playing speeds. It costs $50.

Talking meter

That pipe is spliced into your house water supply, the electronics to your home intercom. From then on, this talking water meter tells you—in a synthesized voice—how much water you've used. Maker: Lawrence Research, 924 Westwood Blvd., Los Angeles, Calif. From $45.



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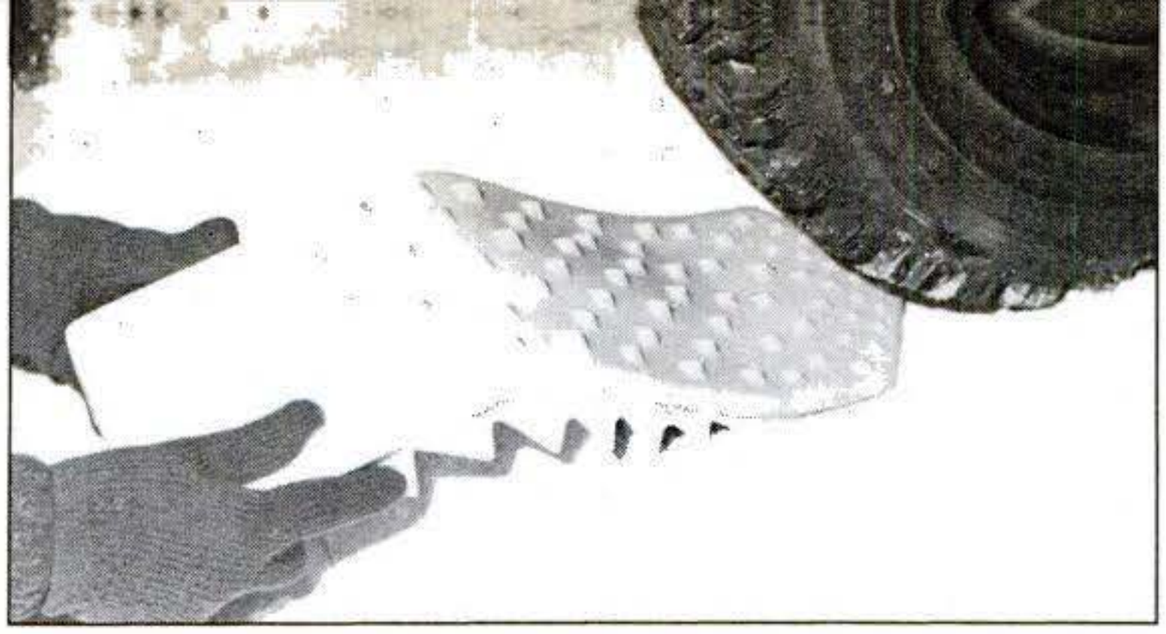
What's New FOR YOUR CAR

BY JACK KEEBLER

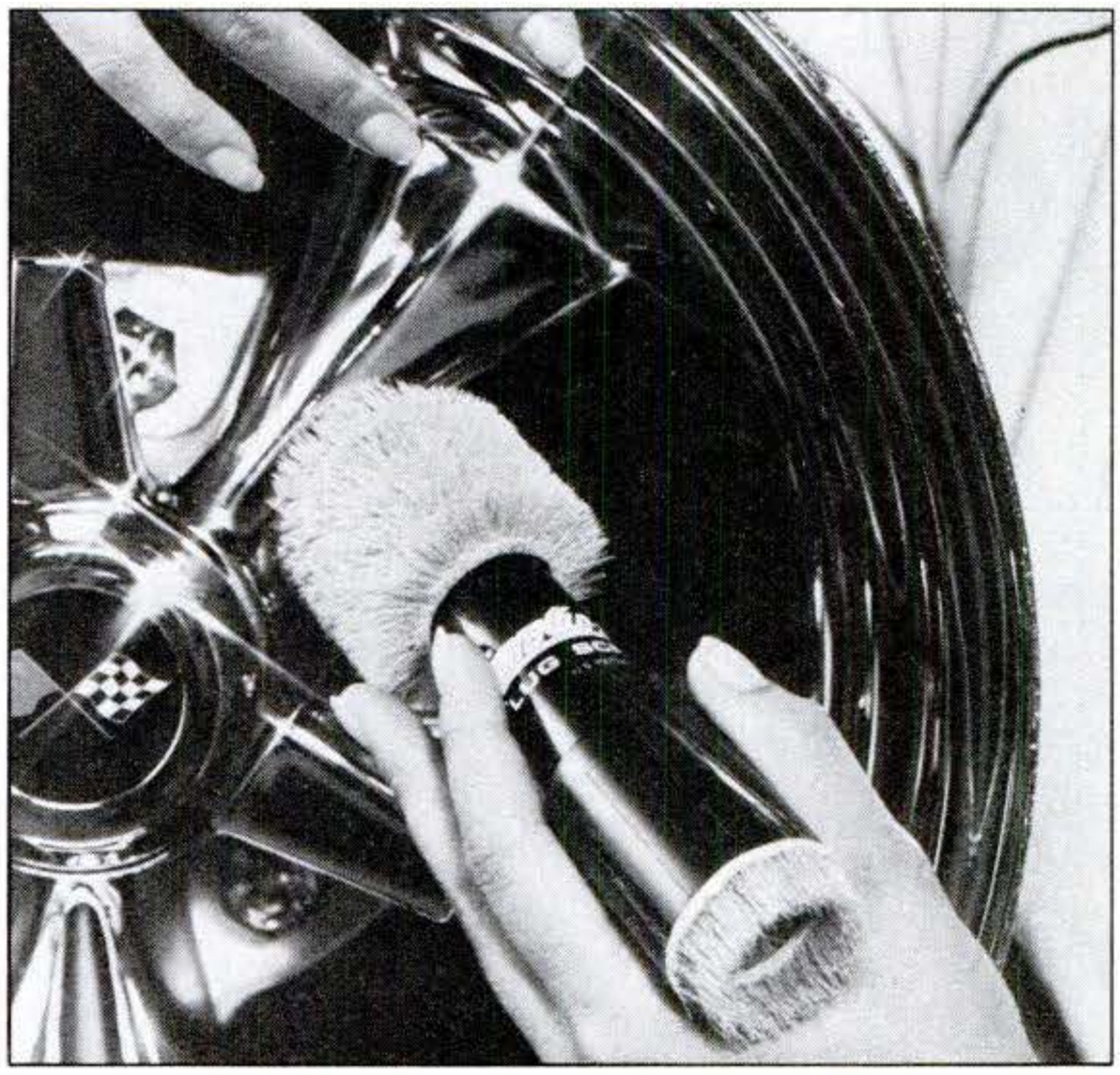


Tire unsticker

Shove this polymer-plastic ramp under a tire that's stuck in snow or on ice: Save-A-Tow's 76 tire-grabbing studs and 12 alligator teeth grip the road for an easy out, says Melloworld Products, Inc. (R.D. 1, Box 331, Slate Hill, N.Y. 10973). It costs $19.95.

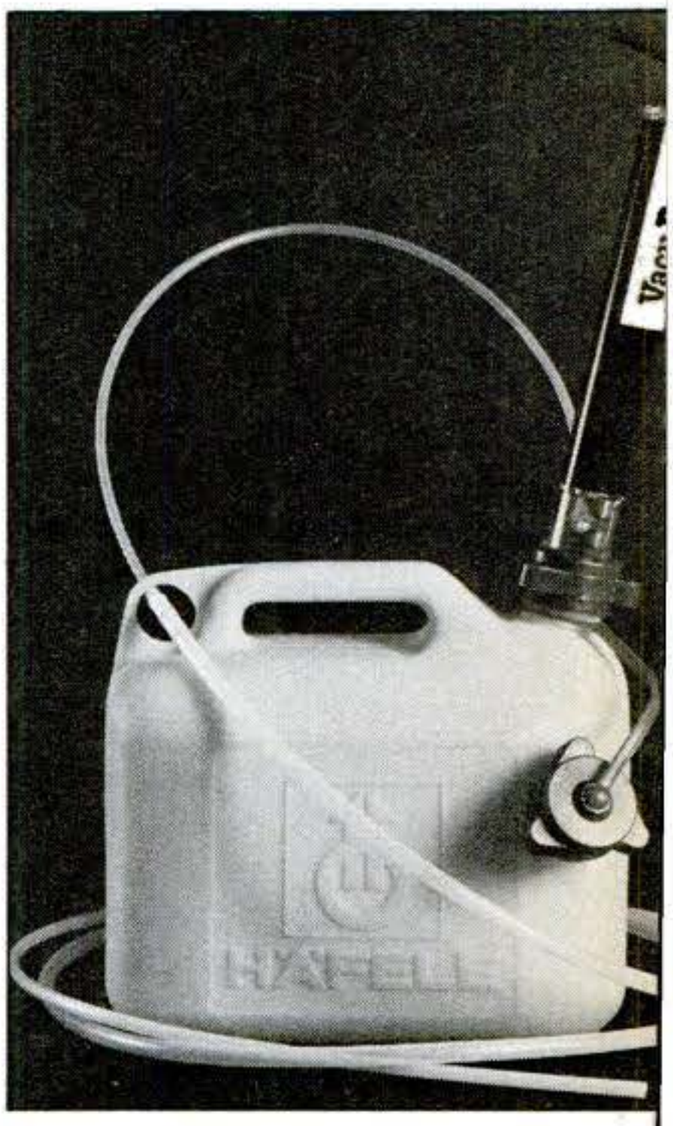
Power for windows

Can't get power windows in your car from the factory? Install your own, says Mitsubishi Electric (7045 No. Ridgeway Ave., Lincolnwood, Ill. 60645). A three-pronged expandable joint locks the motor's shaft to the window mechanism. The price of power is $129.95.



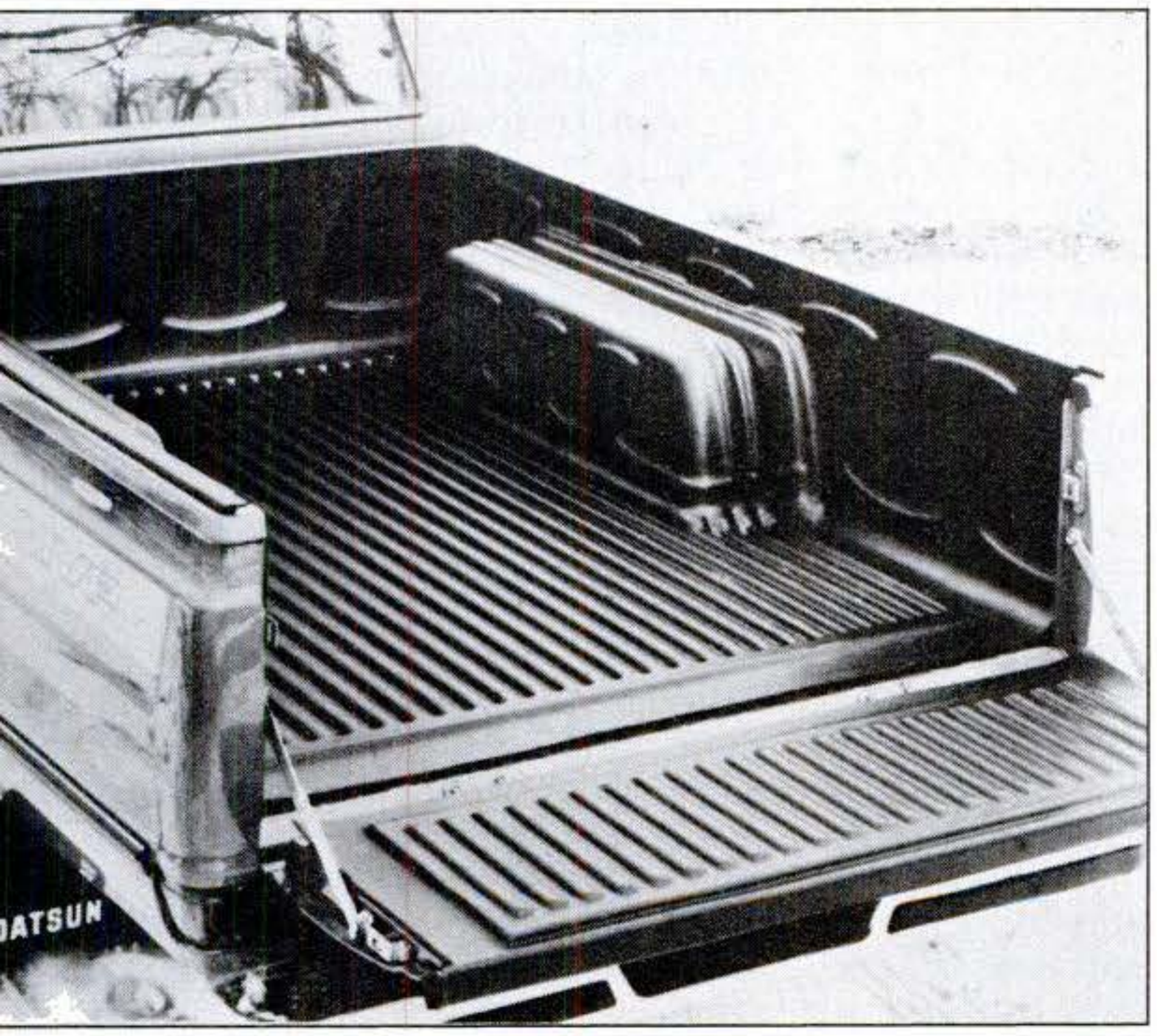
Wheel washer

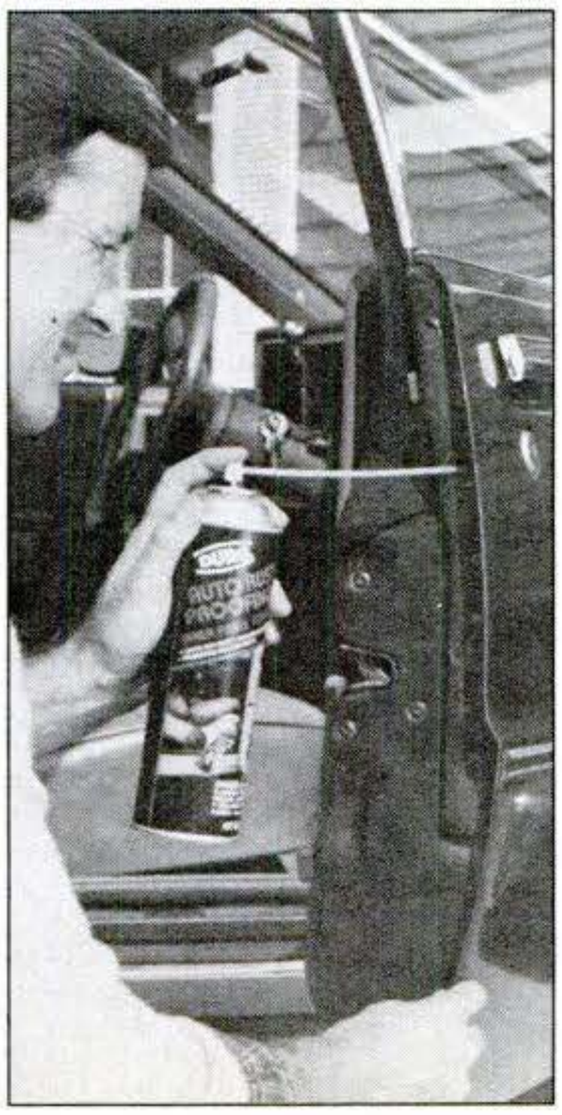
Lug Scrubber makes the time-consuming job of cleaning custom wheels a snap, says Rally Mag Products (Box 1274, Newport Beach, Calif. 92663). Brush bristles inside the cylinder scrub chrome lug nuts clean; the opposite end reaches deeply recessed areas. $8.75.



Load-bed liner

Protect the bed of your import or domestic pickup with a liner of high-density polyethylene, says Coach-Lite Supply Co. (Box 965, Elkhart, Ind. 46515). Liners weigh approximately 60 to 70 pounds, depending on model, and are easy to install. Prices: $200 to $260.



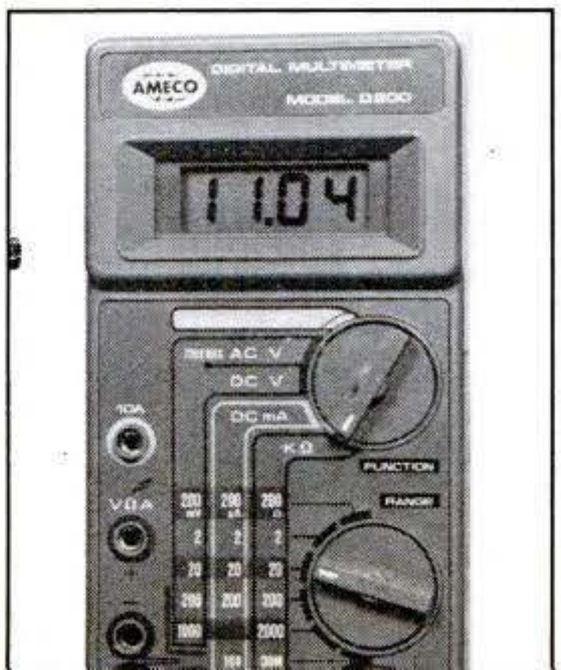


Oil-sump pump

Don't crawl under your car to change the oil. Instead, remove the dipstick and insert the VacuPump hose. Suction draws out the old oil. Remove the pump and cap the five-liter container for safe disposal. Made by VacuPump (12 Hoffman St., Kitchener, Ont. N2M 3M4), it sells for about $25.

LCD multimeter

Tracking down a car's electrical gremlins is easier with a digital multimeter. Model D-200 from Ameco (275 Hillside Ave., Williston Park, N.Y. 11596) features an easy-to-read ½-in. display and is fully protected from overloads. Price: $70.



Rustproofing kit

Duro's rustproofing kit reaches into inner cavities. The kit includes interior and exterior sprays. Both produce waxy coatings that won't crack or harden with age, says Loctite Corp. (4450 Cranwood Court, Cleveland, Ohio 44128). $29.85.

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Now they're here: power mowers with injury-stopping **blade brakes**

The key to selecting the best system for you? Your own mowing habits

By E. F. LINDSLEY
DRAWING BY GERHARD RICHTER

It began just last year: That's when the Consumer Products Safety Commission set new standards for lawnmower safety [PS, March '82]. Every mower built after June 1982 had to be capable of stopping the blade within three seconds after you let go of the handle.

Now the new mowers are on showroom floors. And, as expected, manufacturers are offering three basic safety systems: Two stop the blade by stopping the engine. You restart it with either an electric starter or a pull rope that's extended up the handle. The third system uses a mechanical device to declutch and brake the blade while the engine continues to run.

Which system is best for you? To find out, I talked to mower and engine makers, engineers, and lawn and garden dealers. I also tried all three types of mowers.

My talks with mower makers and equipment dealers confirmed my first impression: Nobody knows which system will sell best. In fact, at least 12 mower makers are hedging their bets by offering all three. And getting clear advice from the pros was difficult: Underneath all the carefully worded responses from the mower makers (some of whom were clearly constrained by legal advisors) is an awareness of the potential for product-liability suits. If manufacturers say a mower is safe—and you get hurt—they're afraid they could be sued. Most preferred to hold their comments to simply, "Our mowers are in compliance."

A few things are clear, however. The additional safety features will cost you more. The more elaborate electric starts, for instance, may cost an additional $100. Here's a rundown on what to expect.

Engine stoppers

Although I try to be objective when testing equipment, I have a rather strong subjective resentment against the electric- and rope-start mowers. I simply don't like the fact that the engine stops every time I do. It's irrational, but I observed the same reaction from friends who tried them. Also, everyone who used the electric-start system asked how much it would cost. When I said about $100 extra, they all recalled buying a whole mower for about that not long ago.

I purposely overworked the electric starter and battery by trying to force a start with the blade dragging in heavy grass. Ordinarily I dip the mower handle to lift the blade clear. But since not everyone does that, I wanted to see the results. My experiment cost me a trip back to the garage and a one-hour battery recharge. (Unfortunately, there is no rope-starting pulley on the engine for emergency use.)

If the electric starting system quits for reasons other than a needed battery recharge, you won't cut grass until you get it fixed by a professional. Looking over the electric starting system convinced me that there were too many things that had to work together for most do-it-yourself mower repairs.

Nevertheless, I would certainly recommend electric starting over the extended-rope starter for anyone who finds delivering a snappy rope pull a difficult or impossible chore. Short of my abuse, both the Briggs and the Tecumseh electric-start systems worked well.

A friend spotted the first problem with the extended-rope starter when he groped awkwardly for the handle on the right side of the mower. "This is all wrong," he said. "I'm left-handed." It was just unnatural for him to hold the bail closed with his left hand and try to pull with his right. If you're a lefty, this is an important point to consider.

For a while, I sailed along with the rope-starter mower with no problem. Then I suddenly realized I wasn't using the rope because I wasn't bagging or stopping the mower.

I remembered one dealer who confessed that he was stocking mostly extended-rope-start mowers. "That long rope is only going to cost about $25 more," he said, "and besides, when the lawns dry out in midsummer, very few bother to bag anyway." He was right.

The rope isn't much of a bother if you aren't doing stop-and-go mowing. But if you're a routine bagger, keep your right arm limber—and keep a new rope on hand, together with the instructions on how to install it. The ropes tend to wear.

Clutch brakes

Many mower owners just don't like the idea of stopping an engine once it's started and, as I've admitted, I'm

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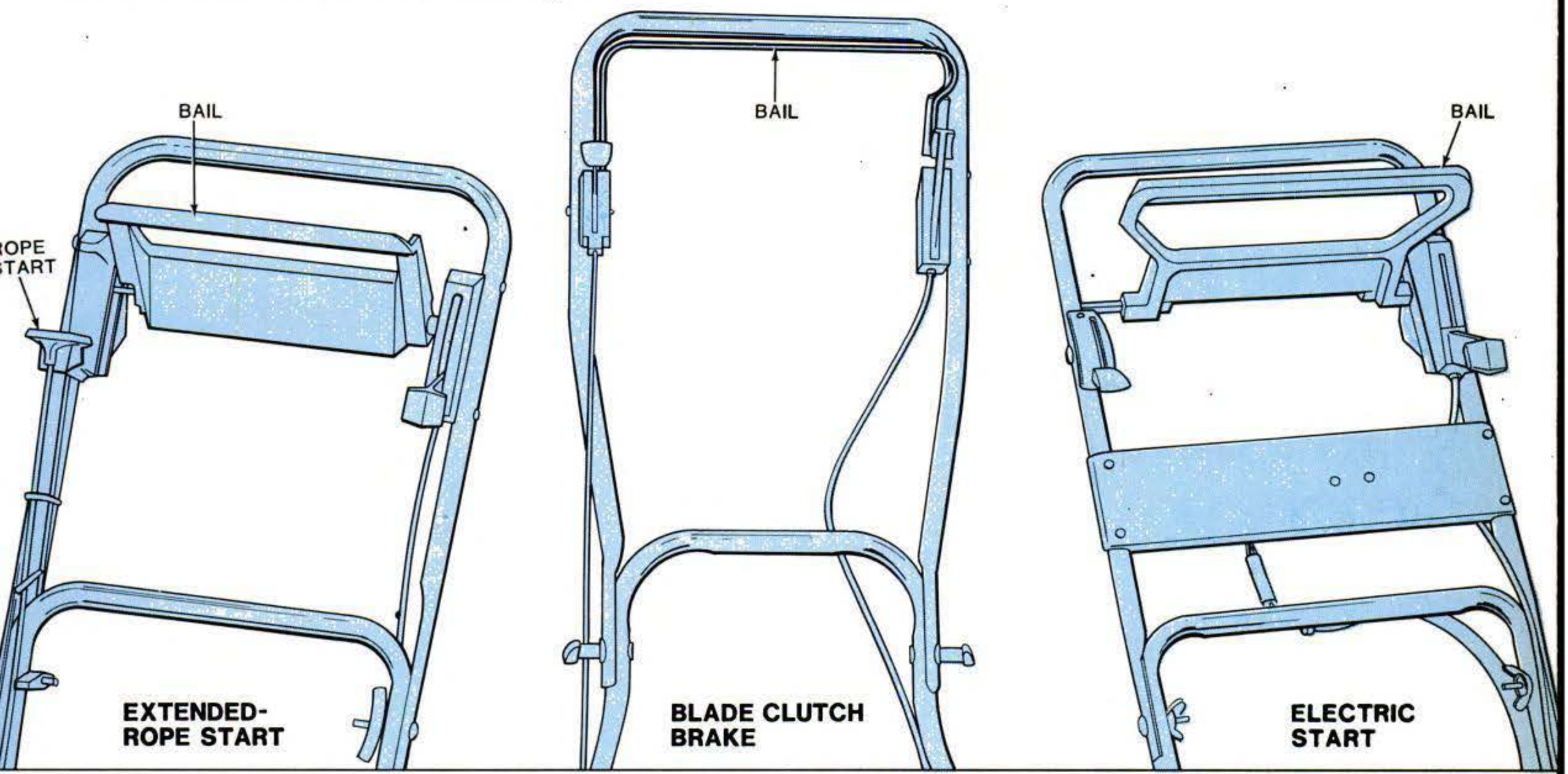
Power-mower blade-brake systems



Extended-rope start: Engine and blade stop in these types of mowers, but to restart you must hold the bail and pull a starter rope, which now extends up the handle to the operator's position. This forces you to keep your hands and feet away from the blade area. Least costly, the price is approximately $25.

Blade clutch brake: Releasing the bail doesn't stop the engine but does declutch and brake the blade. To mow again, you simply grip the bail to release the blade brake and engage the drive clutch. The starter rope is on the engine. You start the engine in the usual way, but the blade doesn't turn until you grip the bail. This system costs about $50.

Electric start: These mowers cut the ignition, and a flywheel brake stops the engine and blade rotation whenever you release the bail on the mower handle. To restart the engine, you grip the bail and pull a lever or turn a key. The engines, battery, and charging alternators have all been modified or boosted in capacity to handle a restart about every two minutes, as when you're bagging. They also have a backup, plug-in charger. The most expensive system, electric start adds up to $100 to the cost of the mower.

one of them. For that and other reasons, I'd choose to spend the approximately $50 extra for a blade clutch brake.

I like being able to start the engine, leave it running, and engage the cutter blade at will. It was handy to stop the blade when I crossed gravel areas and walks. Dropping the bail in and out seemed to be a logical and natural clutching action, much as you'd use a garden-tiller control.

One argument against blade clutch brakes is that they're subject to failure, as is any mass-produced device. And, since you can't see the blade, it might be whirling when you assume it's stopped. (Of course, checking it with your hand is a bit like checking a parachute by jumping out of the plane.)

When an engine stops, you hear it. The difference in sound isn't quite as obvious when you declutch the blade and the engine keeps running.

But my own tests with the Comet-Hoffco clutch brake didn't support that fear. There is a definite difference in sound when the blade is disengaged. And a Roper mower worked smoothly and reliably even after abusive storage out in weather and rain. (This was not true of some clutches I tested a year ago.)

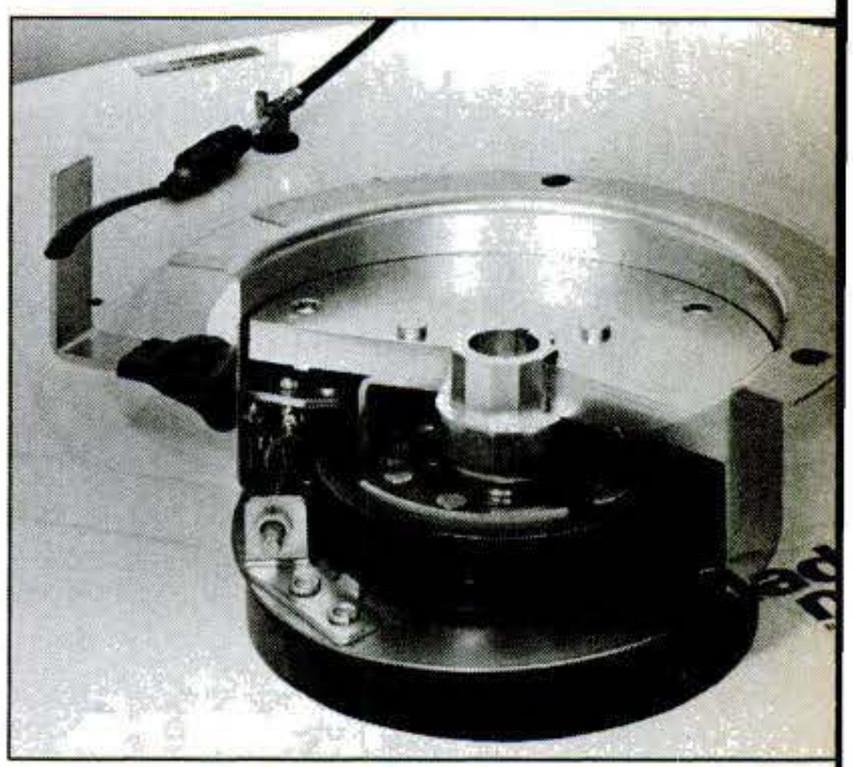
Another charge against the clutch brakes is that they aren't designed for homeowner disassembly and repair. True—and also wise, since an accident due to a makeshift repair could place the maker in line for a lawsuit. (I disassembled them but had to invent and fabricate a few tools to do it.)

All in all, the blade clutch brake seemed by far the most convenient safety system. Only time will tell if its reliability and durability match that convenience.

Another way

Finally, although I didn't try it, there's one other approach that stops the engine but leaves the starting rope on the engine where it's always been. The idea is simple: The mower base is wider than usual. It prevents a probe (simulating a foot) from entering far enough under to be struck by the blade (under carefully prescribed conditions).

The larger base may make it a bit more difficult to mow tight spots, but according to a spokesman for Snapper, "the recoil handle can be located at the engine, which results in easier starting and eliminates frayed and broken ropes."



Cutaway of Comet-Huffco clutch brake shows brake band that stops blade. Built-in flywheel maintains smooth operation.

It's quite possible that someone may still work out a better way to make a safer mower and comply with the regulations. Right now, however, picking the best mower for yourself takes some careful evaluation of your mowing habits.

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Sharpen your chain saw

Two ways to faster, safer wood cutting

"ELECTRIC SHARPENERS SUIT ME FINE"

By A. J. HAND

Even after more than 10 years of cutting all my own firewood, I'm still amazed at the way a sharp chain saw eats its way through a tough log—it's almost as though the saw were being mysteriously drawn into the wood.

Let that same chain get dull, however, and the magic disappears. Even if you lean on the saw to make it cut, it resists you all the way.

Lately I've discovered one of the best ways to keep saws cutting: electric chain-saw sharpeners. They're fast, easy to use, and give me a sharper chain than any other method I've ever tried. Not only that, they're compact and light enough to take into the field—certain models can run off your vehicle's battery or their own compact battery pack.

For this report, I tested four electric sharpeners: the battery-powered Sharpie (Model 2305) by Wen, a 12-volt Dremel Chainsaver (Model 1241), and a 12-volt Craftsman

Electric chain-saw sharpeners are fast, easy to use. Skilled users can sharpen at rate of a cutter every five seconds. Right, in use: Wen Sharpie (9–12 VDC, $28). From left on logs: 115-VAC Craftsman ($39), 12-VDC Dremel ($32), 12-VDC Craftsman ($34).

"I PREFER HAND FILING"

By NEIL SODERSTROM

A chain saw that runs poorly, or even unpredictably, can still cut wood as long as the chain is well cared for. But if the chain isn't up to the task, even a well-maintained saw won't cut satisfactorily. A chain kept in top condition cuts efficiently and smoothly, reducing wear on the saw's bar, sprocket, and engine while greatly reducing the tendency to kick back. A smooth-running chain also helps reduce vibrations that fatigue your hands and arms.

What's the best way to keep your saw sharp? You can get good results with either a hand file or an electric sharpener. A novice at electric sharpening, though, is sure to need precision jigs, which come only on the higher-priced units. I prefer to do the job by hand because a moderately priced setup ($18 to $25) lets me sharpen as fast and precisely as I could with any electric sharpener, which can range in price from a modest figure way up to $300.

Here's what you need to know to file by hand: You first have to determine when a chain needs sharpening. Owner's manuals suggest a variety of methods. Some say you should look for reflections of light off the leading edges of cutters (sharp edges reflect no light). Others suggest that you sharpen when your chain begins tossing out sawdust rather than wood chips. But the surest sign of a dulling chain is its decreasing appetite for wood.

A properly sharpened chain cuts hungrily downward into a log. If you have to apply pressure to the bar to make the chain cut, stop cutting and either sharpen the chain or switch to a sharp one. Forcing a dull chain overheats it, fatigues chain parts, and causes excessive frictional wear on the bottom of the chain and along the bar rails. If the chain fails to cut straight, with its kerf leading toward the sharper cutters on one side, stop cutting. Otherwise, your bar and chain can be damaged beyond repair.

Tools and techniques for sharpening can vary slightly, depending on whether you have square-cornered-chisel, semi-chisel, or round-cornered-chipper chain. For example, though you can employ a round file or an electrically powered grinding rod on all three kinds of chain, some professional loggers prefer a beveled file for the inner edge of a chisel cutter.

Nearly all DIY hand sharpeners use round files that you push along the inside of the cutter, though there's one fluted-shaft grinder on the market. The most common kind of hand sharpening system, called a file guide, varies widely in configuration and cost. In general, there are two kinds of file guides: those that clamp onto the saw bar and those that do not. The guides that clamp on tend to give you the best control over filing angles and height.

The popularity of bar-mounted sharpeners is undoubtedly due to their reasonable cost, the availability of files of various diameters, and the "feel" that the files give a craftsman. Also, because they need no electricity, they can be taken afield.

A Gamn hand-powered, fluted carbide-shaft grinder al-

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(No. 32H36575) and 115-volt AC Craftsman (No. 32H36577) from Sears.

All four work on the same basic principles: A high-speed motor turns a small, cylindrical grinding stone. The stone comes in three different diameters to fit cutters on various sizes and types of saw chain. A simple guide, mounted on the nose of the sharpener, rides atop the cutter being ground, helping you align the stone with the cutting edge.

To use a sharpener, you mount the guide and adjust it for the right alignment (given in a chart that accompanies it; adjustments vary depending on chain). Then you rest the guide atop a cutter link, line up the mark on the guide plate with your chain bar, and make two or three light strokes across the cutting face. With a little practice, you can do a cutter in about five seconds.

There's little tendency for the chain to wobble or chatter (as it can when you use a file) because the electric sharpeners require only a light touch. This keeps the alignment true and gives a better edge than you're likely to get with a hand file.

Don't expect these tools to send up a shower of sparks and file away metal like a big, professional grinder. They're best at fine work. If you really damage a saw chain—by accidentally cutting rocks, for example, or hitting hardware buried in a tree—you should take your saw to a professional shop. These little grinders are too slow for that kind of work. On the other hand, they are not so fast and powerful that they're likely to burn the temper out of your cutter links, either.

If all four sharpeners that I tried work on basically the same principle, are there any differences between them? You bet there are.

Wen: This is the smallest of the four, and the handiest of the lot for work in the field. It runs on its own battery pack of six D cells. You also can connect it to your car or truck battery; the higher voltage gives a slight boost in grinding speed.

The Wen's guide plate is the easiest to set up and adjust initially, but once in place it's the least convenient to use. The plate is so wide it tends to bump against adjacent chain links. In some cases this just limits the length of your sharpening stroke and concentrates wear on the center of the stone, thus shortening the stone's life. But on chains with closely spaced cutter links, the guide makes it difficult to hold the proper sharpening angle. This didn't bother me too much, though. After I got accustomed to these tools, I used them with the guides removed. This is fairly easy *if* you have experience sharpening chain saws with a file—just try to maintain the angle and shape of the cutter as it comes from the factory. If you're new at the game, however, you should probably stick with the guides, at least at first.

Dremel and Sears Craftsman: These tools look strikingly similar. And with good reason: Dremel makes them all; model for model they're identical except for color.

Their guides are a bit harder to set up than the Wen's. To get the right alignment you have to consult a chart in the owner's manual, then use a small gauge, one or two shims, plus a screwdriver.

Once set up, however, the guides are easy to use. They don't come into contact with adjacent chain links and, unlike the Wen's guide, need not be reversed to sharpen teeth facing opposite sides of the cutter bar. Chucking and unchucking stones is easy, too. Just press a locking button to hold the motor shaft stationary as you put a wrench on the chuck nut.

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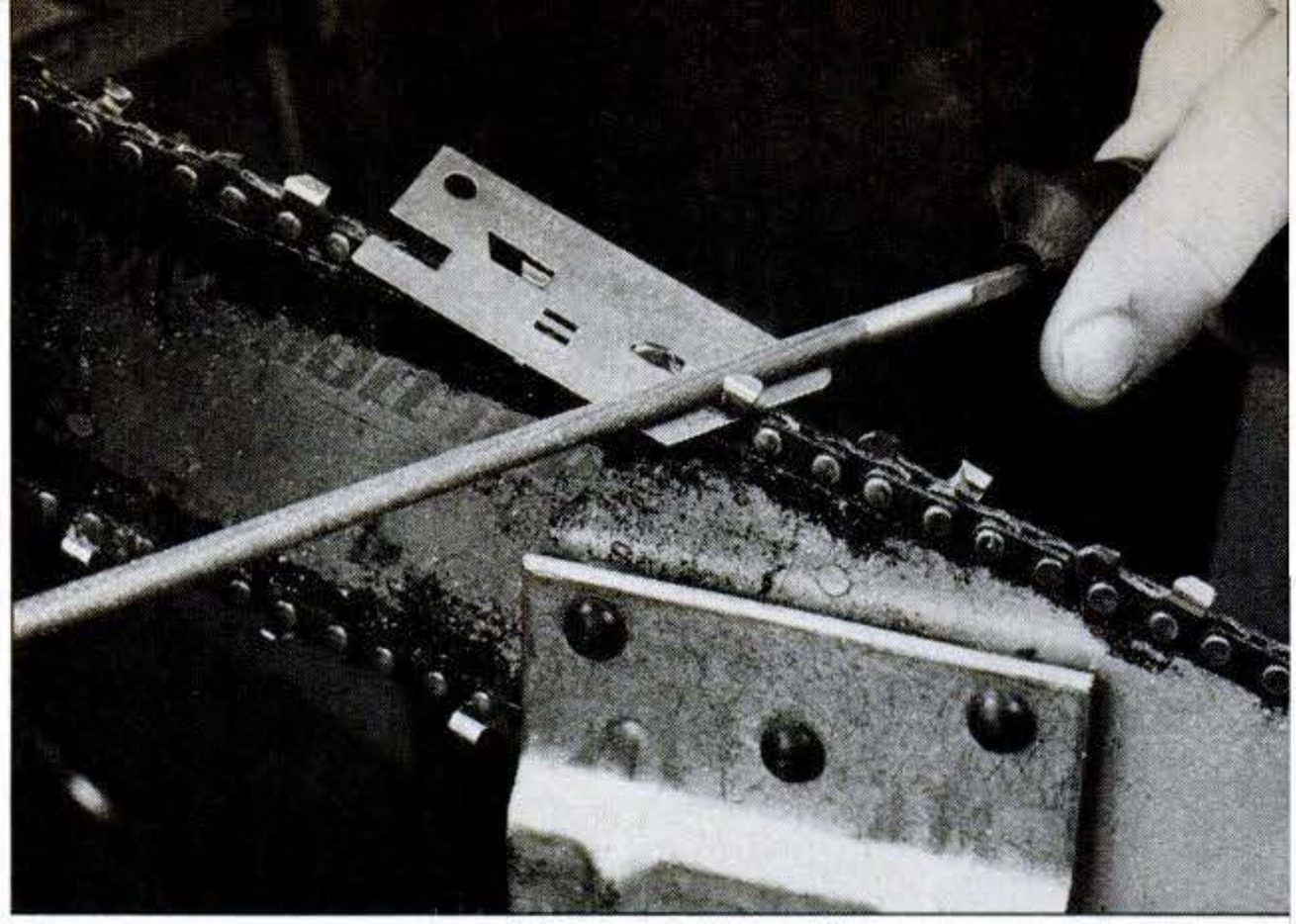
File guides (from left): Sabre rests on top plate; Stihl on top plate, depth gauge; Pferd across two cutters; Oregon—same as Stihl.



File-O-Plate works only on Carlton chain. Guide checks filing angle and depth-gauge height on left- and right-hand cutters.

"HAND FILING" *[Continued]*

lows you to sharpen round-cornered-chipper chain or semi-chisel chain at fixed angles. Though I don't think it's as effective as a good file guide, sharpening with this device can be easy and fairly precise, provided you can envision how the sharpened chain should ultimately look and can establish the correct height for the guide on the saw bar.

Picking the right file

If your chain has no instructions for the size of file to use (because your dealer failed to supply them or you've misplaced them), you can try matching the file's diameter to the factory-ground inner face on the cutter. Common 3/8-inch-pitch chain for mid-size saws is often designed for 7/32-inch-diameter files. But 3/8- and 1/4-inch pitch chains for smaller saws may be designed for 3/16- or 5/32-inch files.

Of course, you can sharpen using a slightly larger or smaller file than prescribed and still get reasonably good—though probably not top—cutting efficiency. In fact, some chain makers recommend that you use a slightly smaller file after you've filed back about half of the original metal on the cutter. Because the top plate of the cutter slopes rearward, away from the cutting edge, the file that you used on a new cutter might begin scraping away metal on drive links after the chain is worn back.

The best files carry imprints of their diameters and makers. No particular grid or cutting face is clearly superior to others. The main concerns are correct file diameter and sufficient abrasive on the file.

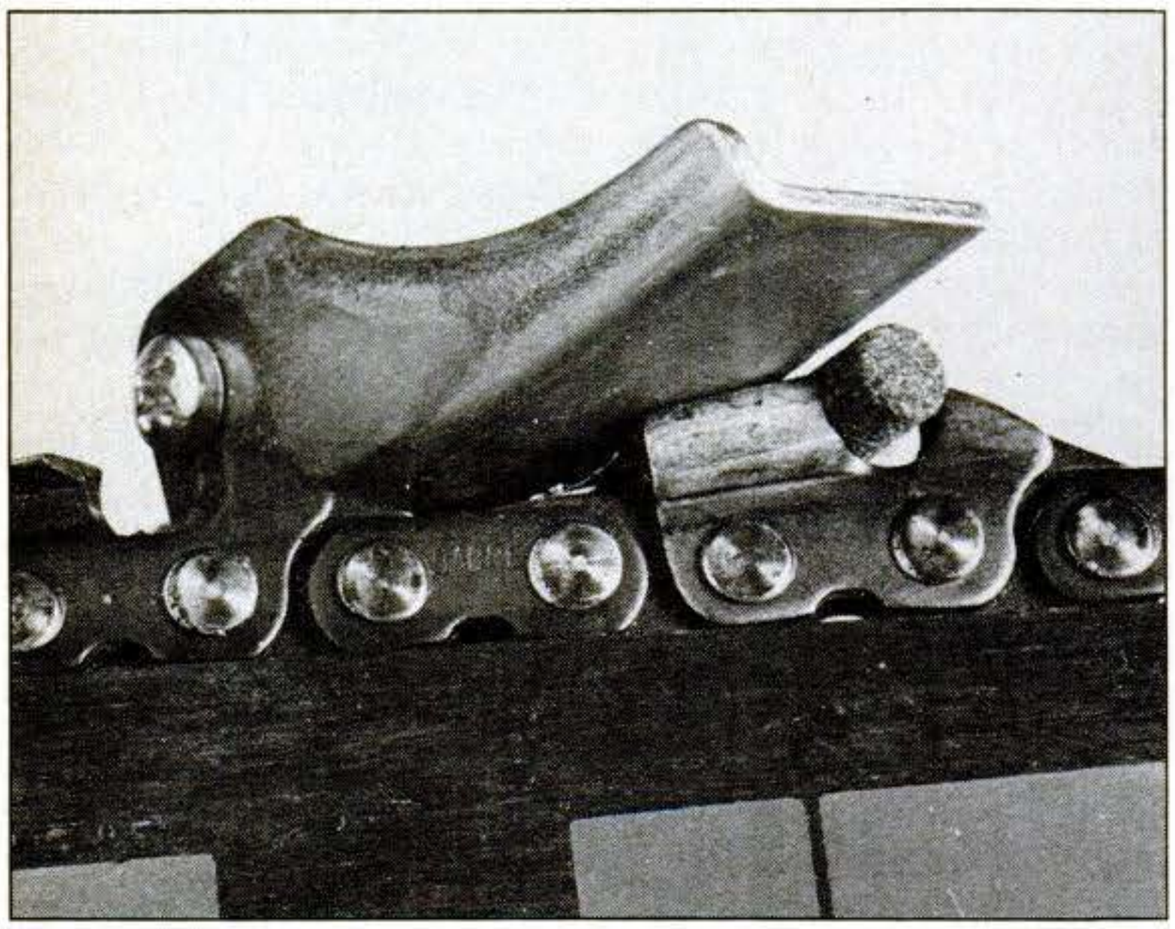
If you use a round file, be sure that it has a uniform diameter for the entire length. Some people mistakenly use a tapered rattail file. This causes highly irregular cutting edges.

Usually, you file a 35-degree cutting angle in the cutter of round-cornered-chipper and semi-chisel chains (used for general cutting), with the file parallel to the top plate of the cutter. And in general, you file a 30-degree angle in

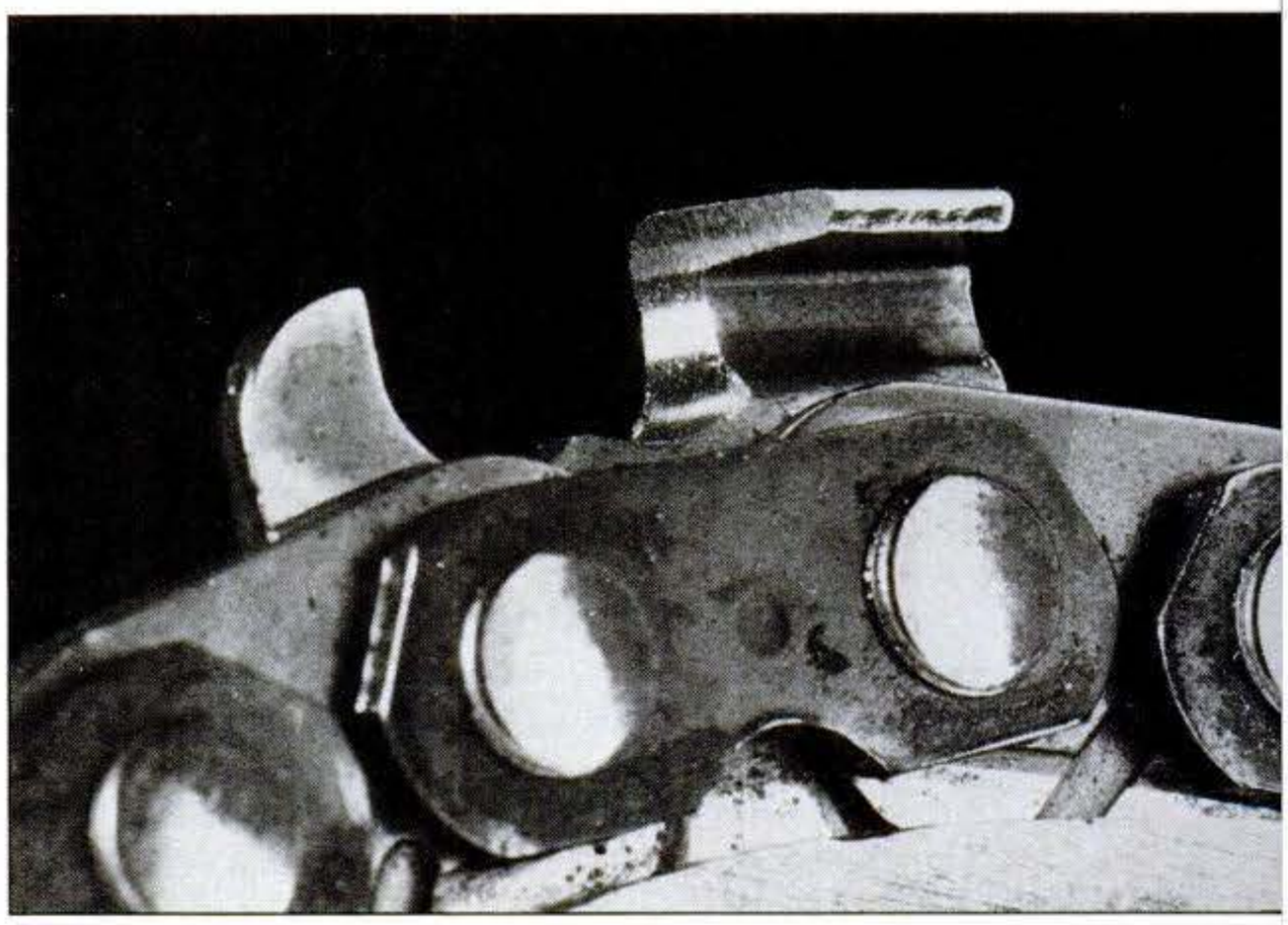
"ELECTRIC SHARPENERS" *[Continued]*

All the models come in kits that include the sharpener, assorted stones, chuck wrench, and, in the case of Wen, a battery pack and a depth-gauge filing guide, which must be used with a hand file. (You shouldn't use the power tool to lower depth gauges.)

My favorites? For price and for keeping a saw sharp in the field, you can't beat the Wen. If you always work in range of your car or truck, then either the 12-volt Dremel or Craftsman might be a better choice. I favor these two



Guide for electric sharpener rides atop tooth being sharpened while you stroke the stone across the cutting edge.



Often, small electrics can produce a finer edge than you can get from a professional grinding machine used in a sharpening

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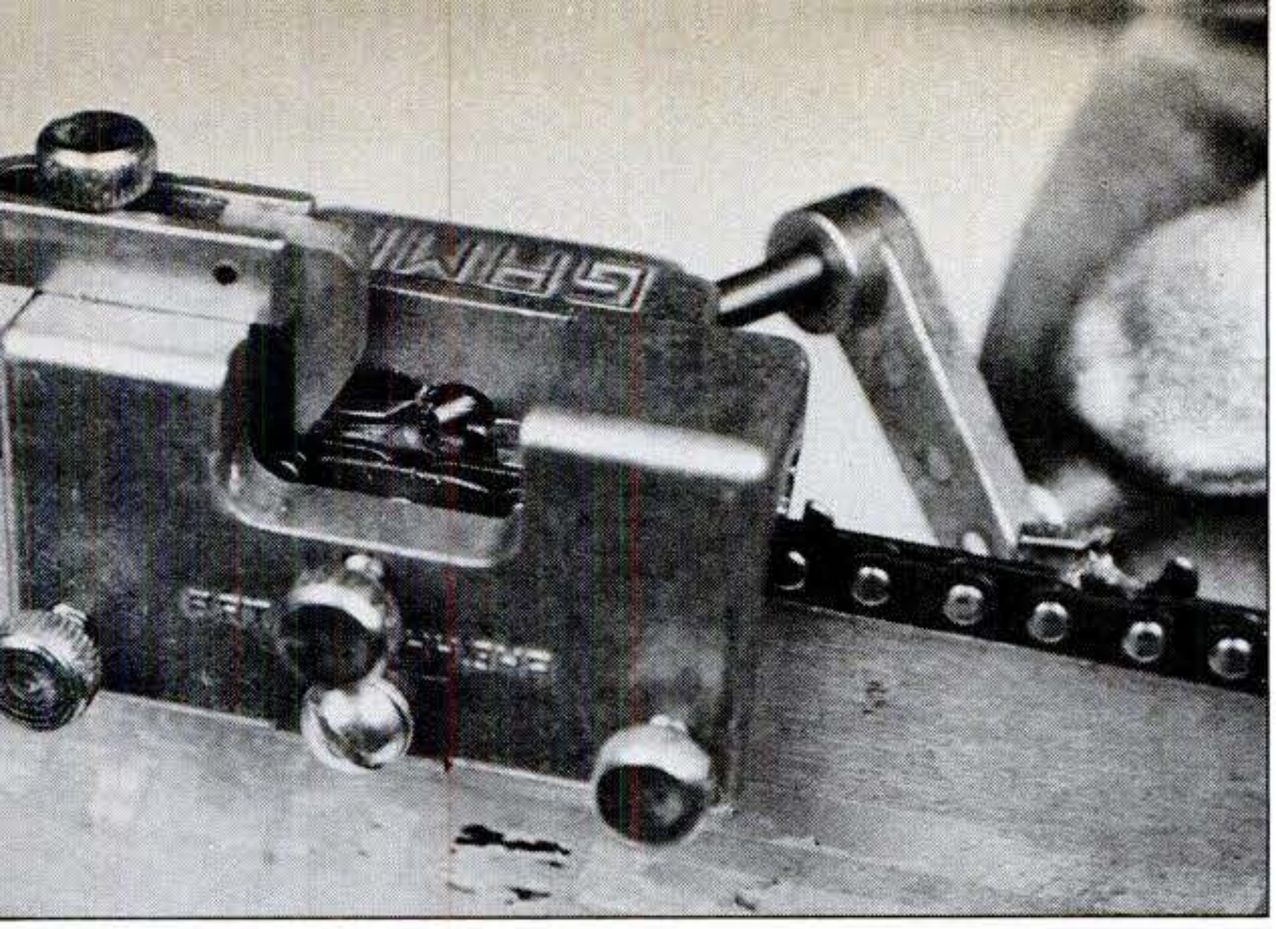
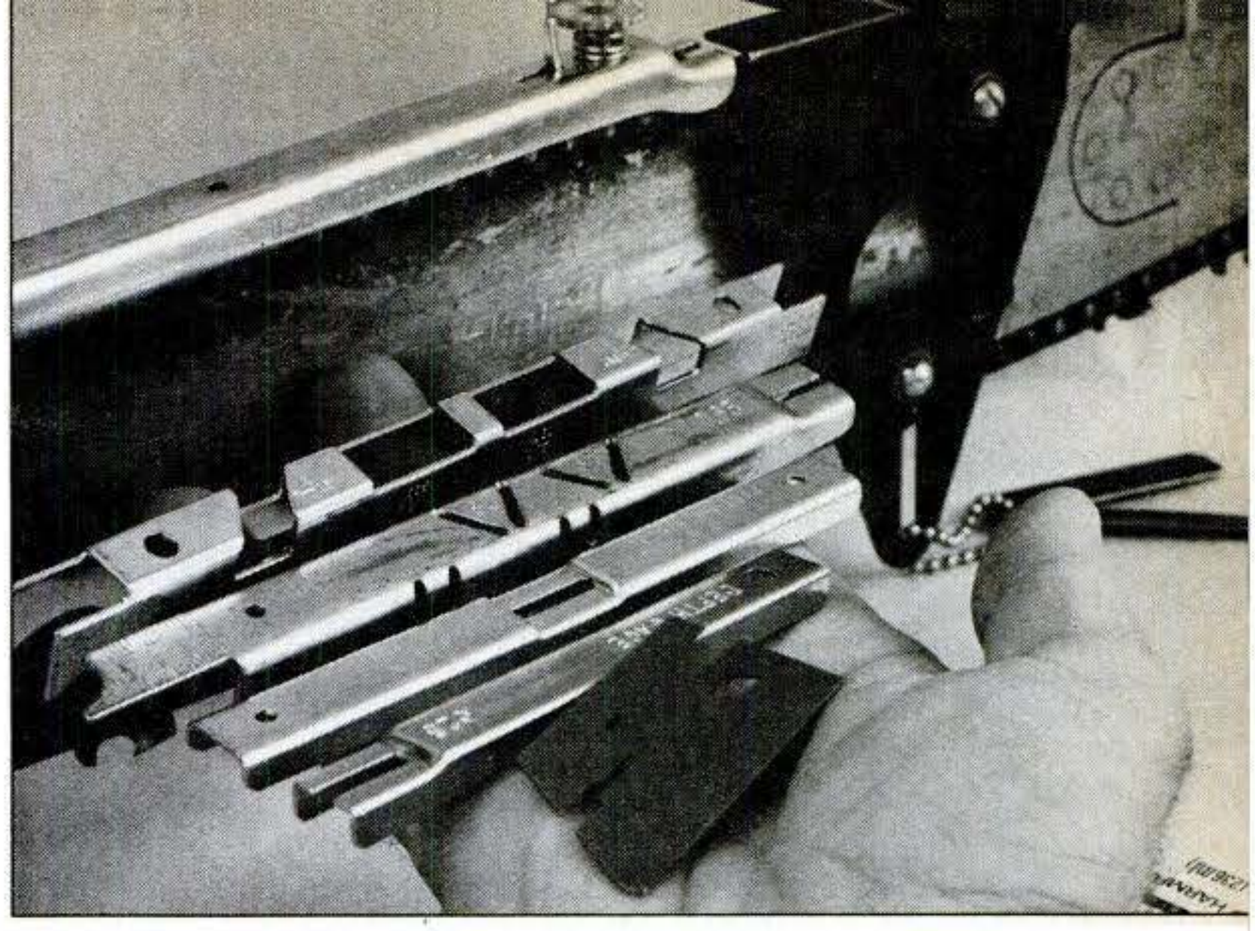


Gamn sharpener features a fluted carbide grinding shaft that you turn with crank. Angle is fixed at 33 degrees, zero slope.



Depth-gauge guides (from left): Sabre, Stihl, Oregon, Oregon end-depressed, Carlton. On bar: Oregon Gaugit and Pioneer.

the cutter of a chisel chain, with the file angled downward 10 degrees on the inside of the cutter. Again, clamp-on file guides hold these angles; you have to rely on your eye to maintain the proper angles with a file guide that doesn't clamp on.

Aside from filing angles, you should pay close attention to the distance the file or grinder projects above the top plate. The smaller the projection, the greater forward "hook" the cutter will have. The greater the projection, the more vertical or back-slanting the profile. On round-cornered-chipper and semi-chisel chain, the best profile is close to vertical or back-slanting to 85 degrees rather than hooked forward. You get this by filing with one-fifth of the file or grinder projecting above the top plate. Initially, a sharply hooked cutter usually cuts faster than a properly sharpened chain, but it soon dulls because its leading edges are too thin.

The actual process of filing is fairly simple. If you use a file guide that clamps onto the bar, just set the angles at which you'll file and adjust for proper file height, following recommendations of the chain or file-guide manufacturer. Once set, you file the most worn-back cutter until its edges are sharp, pull the chain forward to the next cutter with its inside face toward you, and file until that cutter is filed back as far as the first one. Continue until you have done all cutters on that side, then reset the file guide for cutters on the other side. Remember, cutter top plates slope backward, so cutters must be filed back to equal lengths so that they will be of equal heights. Cutter height becomes the reference for filing crucial depth-gauge heights.

Neglected depth gauge

Cutters can be sharpened to perfection and still cut poorly or not at all. Why? Because the cutting edges that slice the wood depend on the depth gauge just in front to limit the amount of bite taken. This is a very important point. In fact, one chain maker contends that incorrect depth-gauge settings cause more chain failures than any other factor.

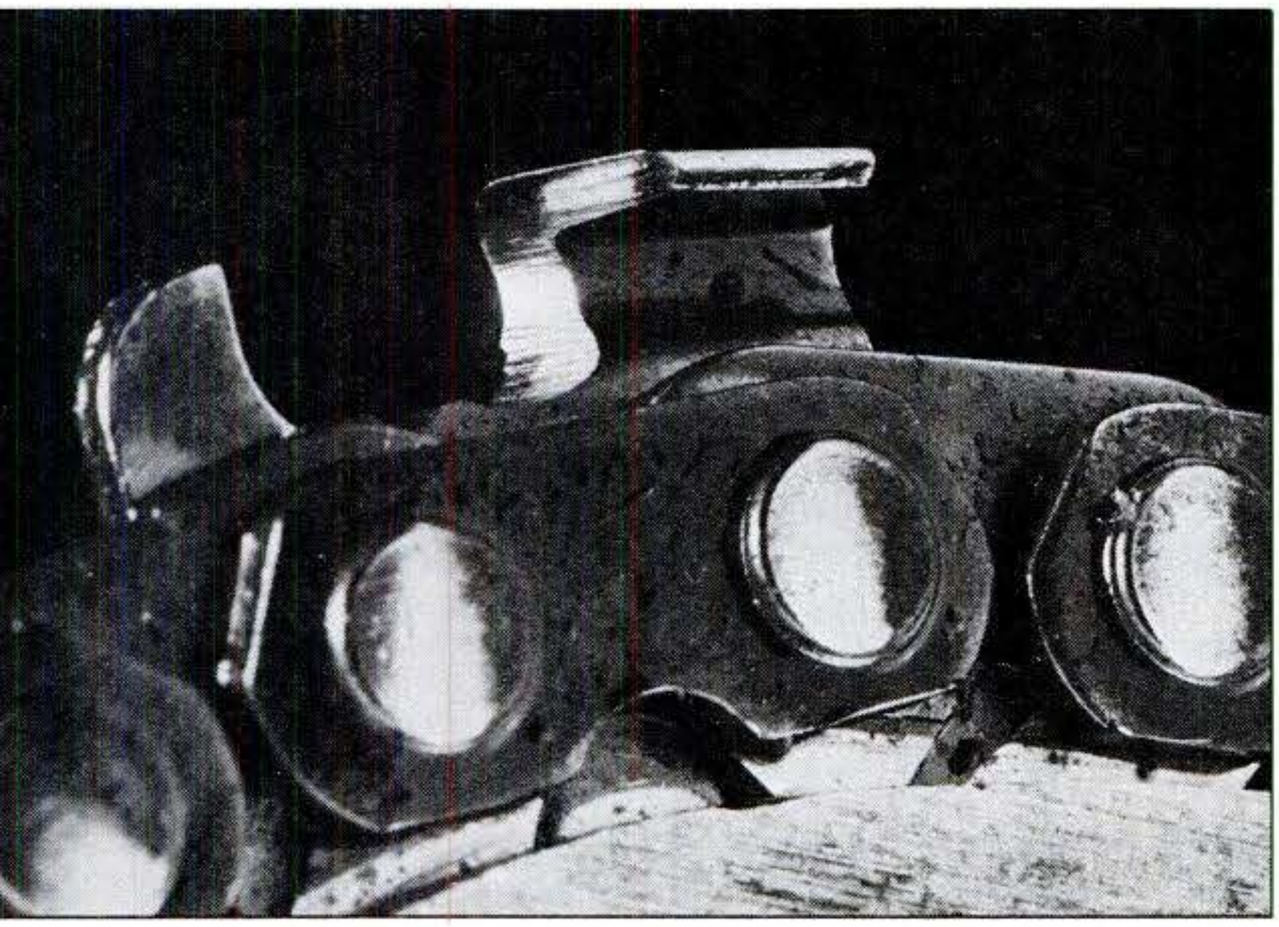
If the depth gauges allow the cutter to take little or no

Continued

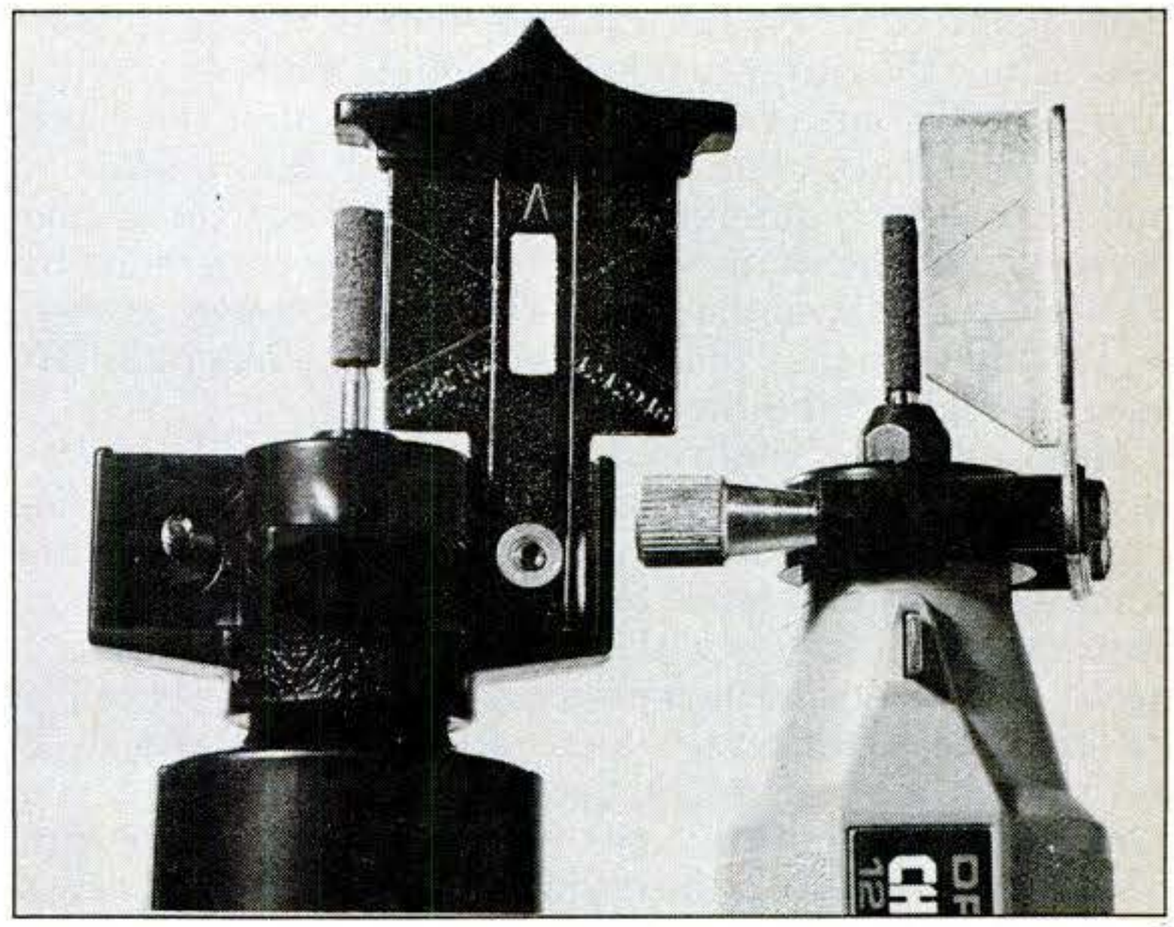
models because of their less troublesome guide systems.

Note that both Sears and Dremel offer 12-volt converters (for about $20) that let you use the tools indoors. The Sears model is more convenient. It has husky lugs onto which you can clamp the battery clips of your sharpener's power cord. With the Dremel converter you must remove the battery clips from the cord and screw the leads directly to terminal lugs on the converter.

The 115-volt unit is fine if you know you'll never need to sharpen your saw in the field. But since the battery-powered units work just as well and cost less, to boot, I favor them over the AC model. PS



shop. Compare photos: At left is a cutter link sharpened by author; photo above shows a link sharpened by a professional.



Guide on Wen Sharpie (left) bumps adjacent chain links—narrow plate on Dremel doesn't. Wen is easier to set up and adjust.

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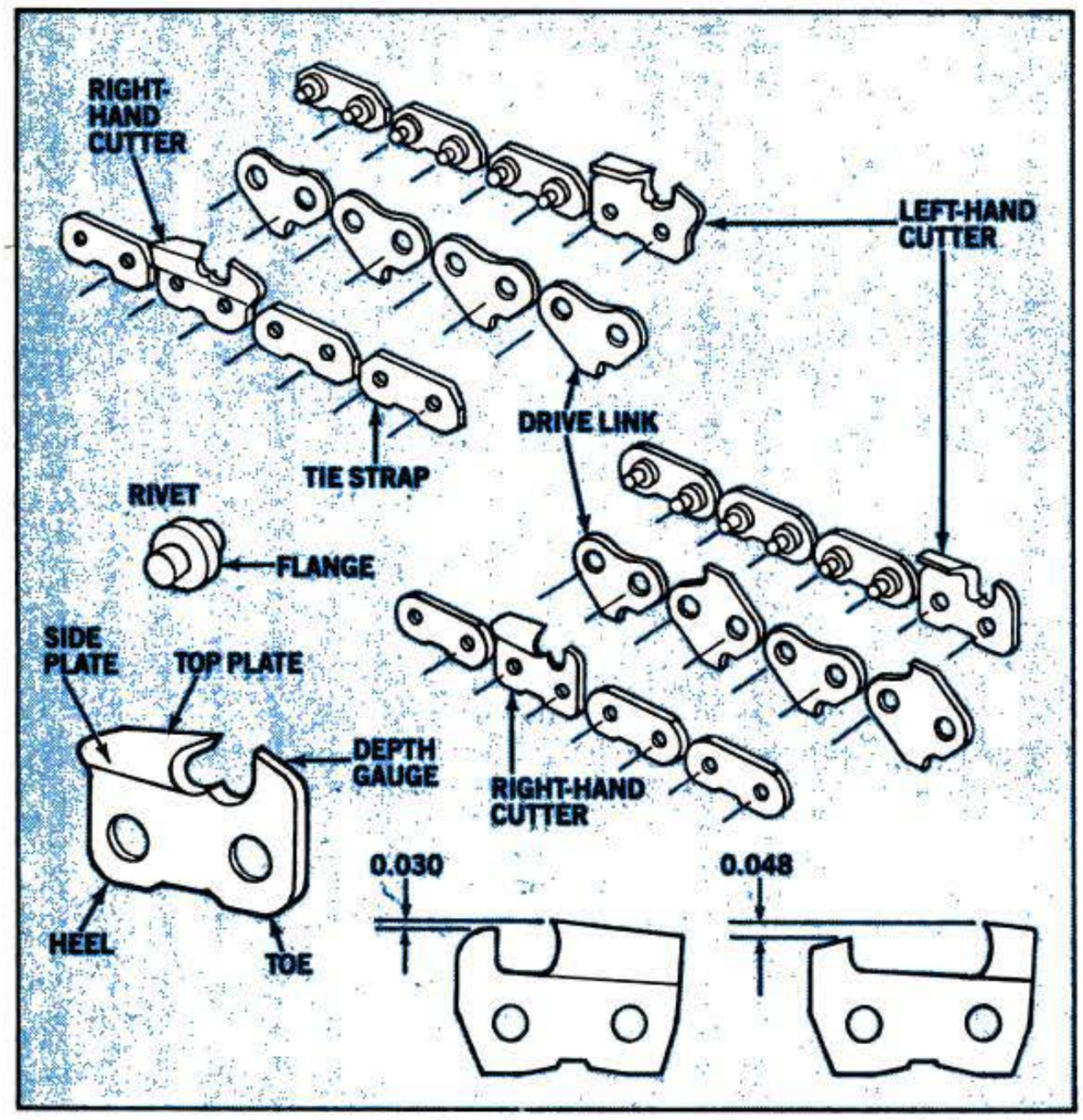
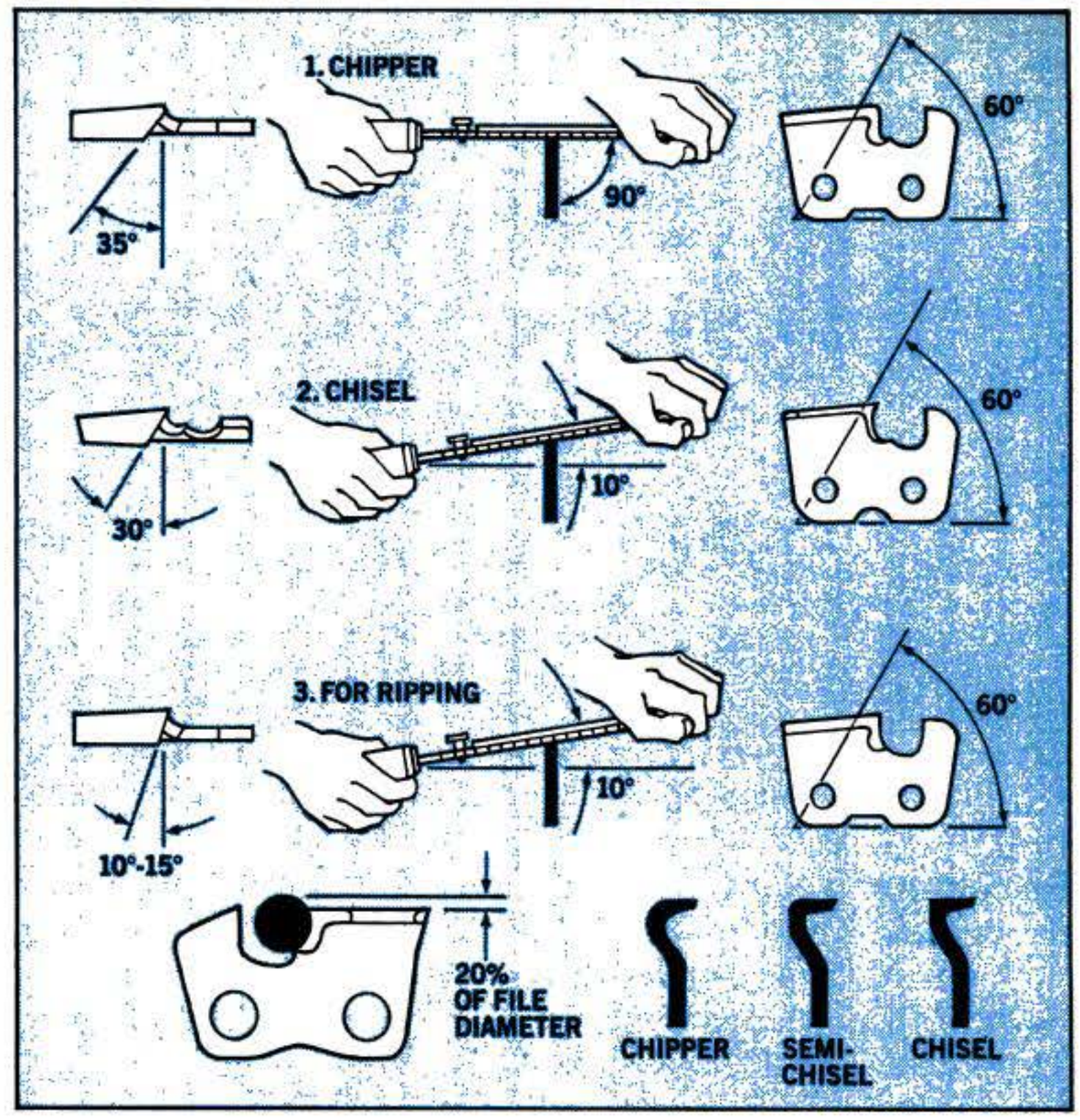


Exploded view of chain (top) shows gently ramped drive links and deflector depth gauges. Lower view shows high deflectors on alternate drive links and standard depth gauges. A typical rivet and cutter link are shown at left. Bottom drawings: A filed-back cutter won't take the same size bite that it did when new unless you lower the depth gauge. Because top plate slopes, filed cutting edges become lower in relation to depth gauge. Most chain comes with gauges 0.025 to 0.040 inch below cutters.



Filing angles recommended for chipper and chisel chain are shown in diagrams 1 and 2. If you use your saw for ripping, you should sharpen at the angles shown in diagram 3. Bottom left: Depending on design of the chain, you should sharpen with 10 to 20 percent of the file above the cutting edge of the top plate. On chipper and semi-chisel chain, this results in a nearly vertical angle for the side plate. Chisel chain should have a slight hook. Bottom right: end-on view of three kinds of cutters.

bite, you may tend to apply more pressure when sawing, causing excessive wear on the heel of each cutter as it's forced to drag along the bar rails. Also, uneven settings can cause rough cutting, chain chatter, and excessive vibrations at the saw handles.

To prevent chain failures resulting from incorrect filing of depth gauges, keep this in mind: For new chain ranging from ¼- to ½-inch pitch, manufacturers usually recommend that depth gauges be only 0.025 to 0.040 inch below the top of the cutter. A dime is about 0.050 thick, so depth settings on small chains need be only half the thickness of a dime.

As you file the cutter back, you should lower the depth gauge because the decreasing cutter height and increasing distance between each cutter and its depth gauge—and the consequent effect on the rocking motion of the cutter—won't allow the cutter to take as complete a bite as when it was new. (The cutter won't take full bites unless the depth gauge permits it.) For example, a cutter that originally had a 0.030-inch difference in height between cutter and depth gauge should have about 0.048-inch difference by the time you've filed the cutter way back. (Oregon, however, recommends that you maintain the same height difference throughout the life of its chain.)

Many makers of chain and sharpeners advise you to lower depth gauges *before* sharpening the cutter. This is because many depth-gauge guides must be positioned on top of cutters, and that tends to dull cutter edges if you press hard when filing down the depth gauge. But lowering depth gauges first causes problems when you need to file cutters back significantly. Because cutter top plates slope to the rear, and, therefore, become lower when filed, you can't truly file depth gauges uniformly until you've finished filing the cutters. So if the cutter requires significant filing, lower the depth gauges after filing.

A compromise: First file all cutters uniformly, then lower all depth gauges uniformly. After that, lightly touch up all cutting edges again. If you're willing to go this far, though, you are close to becoming a sharpening craftsman—if not a fanatic.

If you use a file guide without the bar-clamping feature, you must depend largely on your eye and "feel" to get the correct angles. This invariably leads to imprecision. Still, the filing process is much the same as with clamp-on guides: Tighten the chain to prevent tilting as you file; lightly stroke all cutters on one side and then the other as uniformly as possible.

When sharpening with any file, mount the bar in a special bar vise to prevent the diagonal stroke of the file from pushing the bar away from you. The best bar vises swivel horizontally so you can rotate the saw bar's left and right sides in front of you, making it easy to file both right- and left-hand cutters from the same position. Normally, you won't need a bar vise when sharpening with a fluted-shaft grinder because it applies only light pressure to the cutters in the direction of the saw engine (the engine helps keep the bar stable). When you use a hand file, though, you'll find that a vise can be a great asset.

You probably won't need to file the front of the drive tang, provided you've maintained the bar and the rest of the chain properly and you've kept a worn drive sprocket from damaging the toe of the tang. For minor problems: First remedy the cause of damage, then restore the forward hook on each tang so that it can remove wood chips from the bar groove effectively. A round file works best for this. PS

Neil Soderstrom is the author of Chainsaw Savvy, *just published by Morgan & Morgan, 145 Palisade St., Dobbs Ferry, N.Y. 10522. This $9.95, 144-page paperback is a complete guide to sharpening, cutting, and trouble-shooting.*

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Build extra living space within your present walls

Part 2

This month: How to build stairways, sound-resistant walls—plus lighting tips for rooms with low ceilings

By RICHARD STEPLER
DESIGN BY JEFF MILSTEIN

This three-part series shows how we transformed our 1,500-square-foot home and added more than 200 square feet by sandwiching in a mezzanine, or second floor.

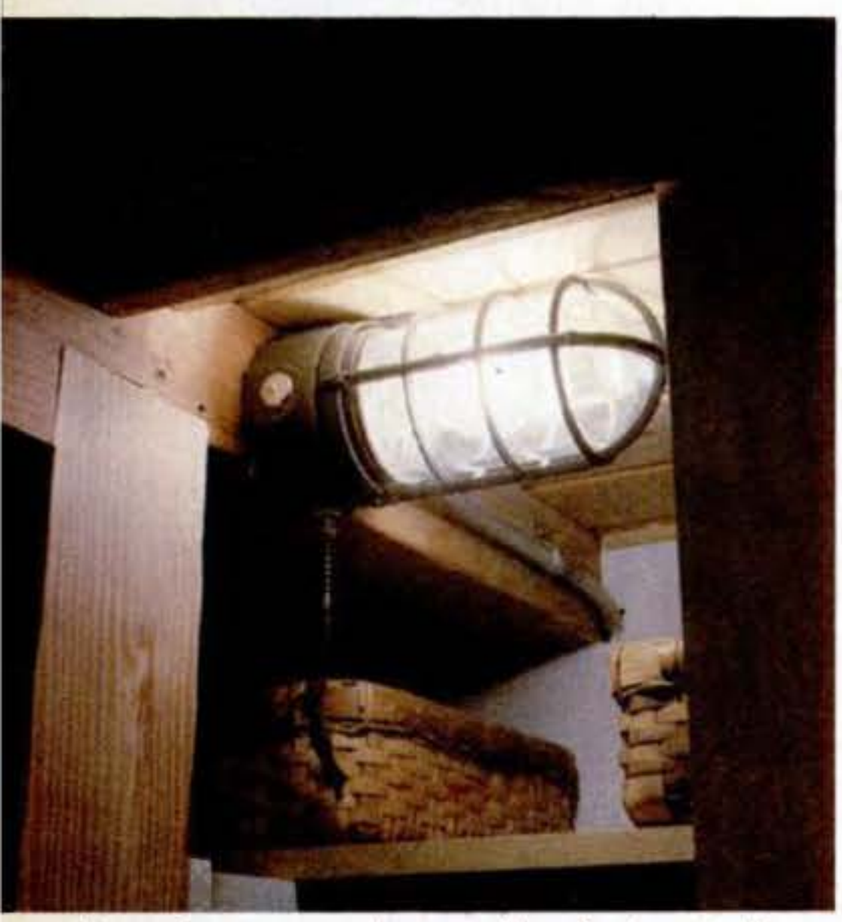
Last month, I detailed the construction of our complete interior renovation through the installation of the tongue-and-groove decking for the second story (see floor plan, overleaf). When the deck was finished, the project began to look as though we were building a small house inside our home. Of course, plenty of work remained.

Architect Jeff Milstein's plans called for a stairway for access to the master bedroom. (For the guest bedroom's smaller and higher sleeping loft, we opted for a simple ladder, shown in the photo at right.) Because of our tight space limitations, the stairway is only 24 inches wide, just adequate for one-way traffic. It also rises at a 45-degree angle. That's about as steep a stair as you'd want to use in residential construction, according to Humanscale, a design guide published by MIT Press [PS, July '75]. Humanscale specifies a 45-

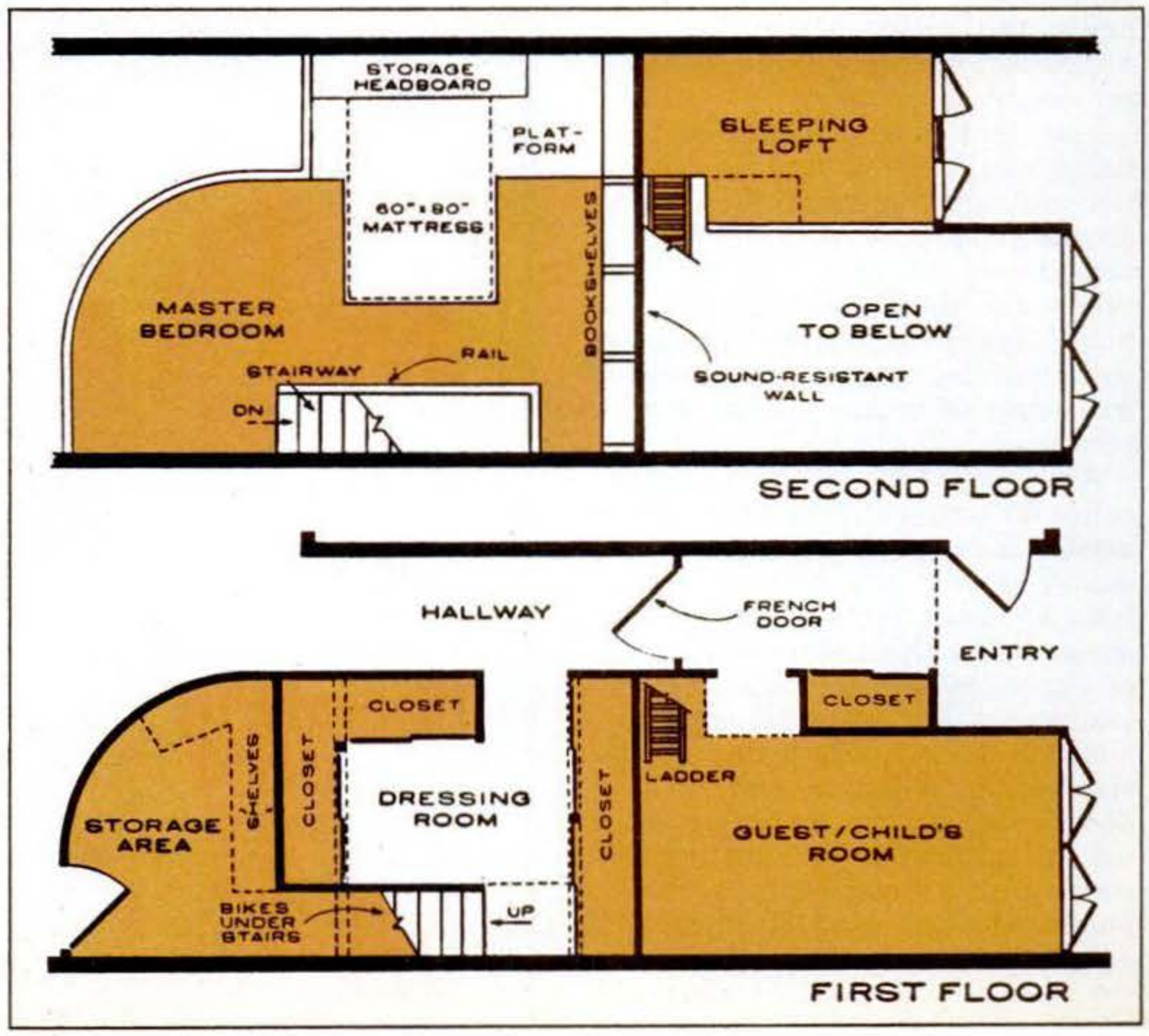
Continued

Stacked steel casements (above) open into dining room; they provide light and ventilation for guest bedroom, which has no exterior wall (see floor plan, next page). Translucent glass gives privacy yet allows light to pass. Horizontal beam is a doubled 2×4 faced with metal channels and painted to match the windows. Oak ladder (left) provides access to guest room's sleeping loft.

CONSTRUCTION BY CHICK SGROI, PHOTOS BY GREG SHARKO



Dressing room has walls of closets (top, left). Birch-veneer sliding doors hang on Stanley's extruded-aluminum tracks and adjustable nylon rollers. Shaker-style pegboard mounted on one wall of dressing room is handy for hanging clothes (top right). Behind wall: stair to master bedroom. Photo above shows one of the industrial shielded light fixtures we used inside closets (see text).



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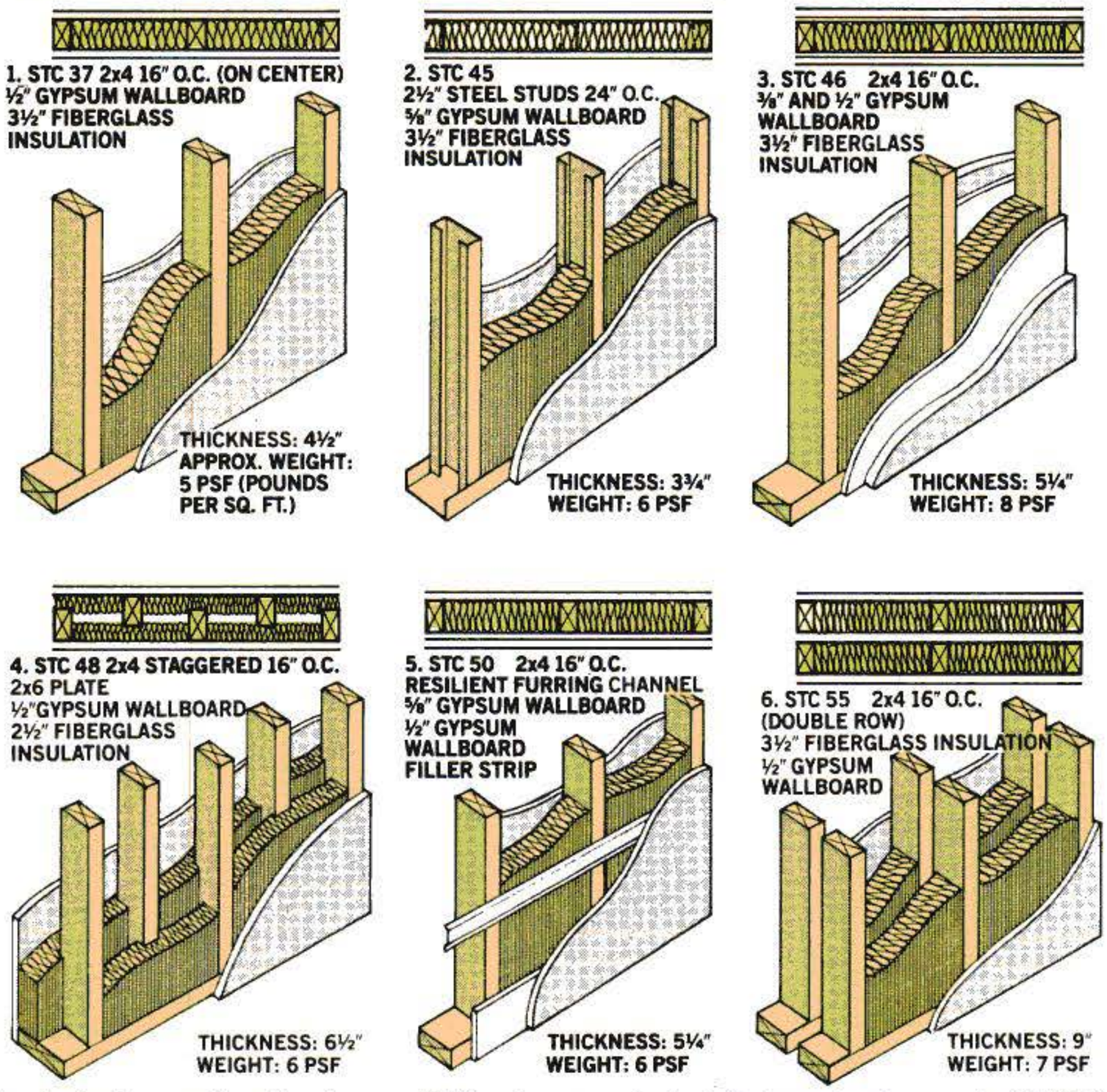
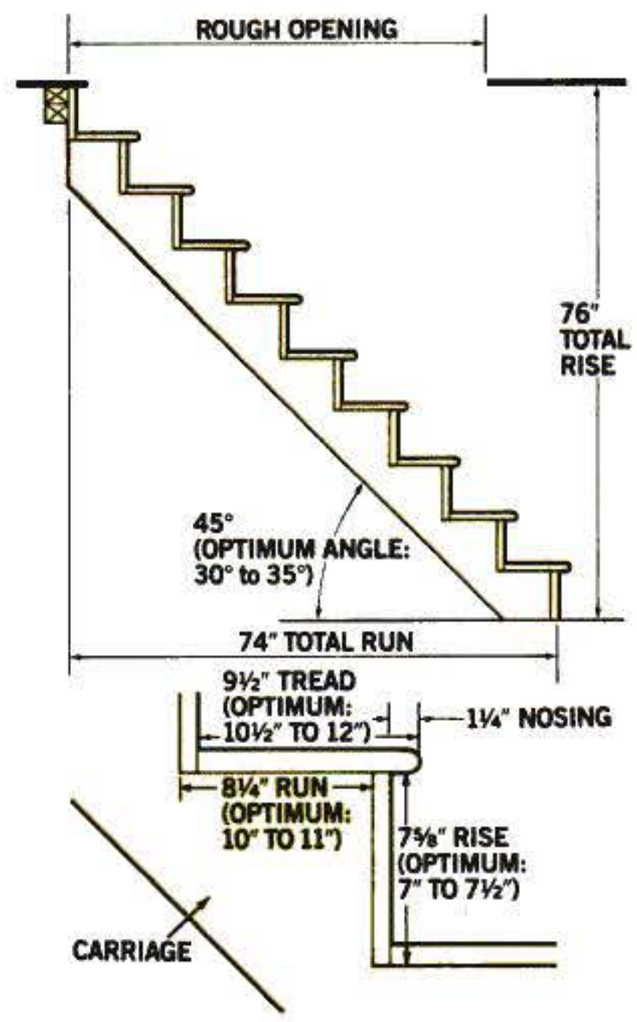
How to build sound-resistant walls



For typical sound walls shown, STC ratings indicate how well a wall stops noise. Here's what they mean in terms of blocking loud speech, according to Certainteed: STC 30—loud speech audible and understandable; STC 35—loud speech audible but not understandable; STC 40—loud speech barely audible; STC 45—you must strain to hear loud speech; STC 50—loud speech not audible. There are three ways to reduce sound transmission: added mass, with extra layers of gypsum board; discontinuous construction to minimize direct connection of wall materials; and fiberglass batts to absorb sound in the wall.

How to build stairways



The most comfortable angle for a stairway is 30 to 35 degrees, but any angle between 20 and 50 degrees is possible. Minimum width for a stair is 24 in.; for two-way traffic, width should be at least 36 in. If you follow these rules, the stairway will be safe and comfortable to use: 1 run + 1 riser = 17 to 18 in.; 1 run + 2 risers = 24 to 25 in.; 1 run × 1 riser = 70 to 75 in. Generally 30- to 35-degree stairs are designed with a rise of 7 to 7½ in. and a run of 10 to 11 in. The run plus the nosing give the tread width. It's essential that all risers be equal and all treads be equal, or you'll trip on uneven steps.

degree stair with eight-inch risers and nine-inch treads, including the nosing (see "How to Build Stairways," above). In our case we had a total rise of 76 inches and a total run of 74 inches. That allowed 10 risers at 7⅝ inches and nine treads at 9½ inches, including a 1¼-inch nosing. While it's not intended for continuous use, the stairway is more than adequate for access to a single room. It's also reasonably comfortable to climb and descend, keeping in mind that it is a short flight of stairs. For most general-purpose stairs, however, follow the guidelines outlined in the box above.

For privacy between the adjoining bedrooms, plans called for a sound-resistant wall. We decided on a wall that provides an STC (sound-transmission class) rating of 50. (For an explanation of STC ratings and alternative methods of construction, see "How to Build Sound-Resistant Walls," above.) At 5¼ inches thick (see example 5, above), the wall takes up almost no more space than a normal partition. It uses metal channels applied horizontally on 24-inch centers to studs to minimize the direct connection of drywall on one side. Fiberglass batts fill stud cavities to further reduce sound transmission. In sound-wall construction, it's important to seal all joints carefully; we caulked around all edges—and all electrical outlets, as well.

When framing is complete, electrical work can be done. While electricians installed the wiring (required by code in my locality), we started the drywall, taking care not to enclose *both* sides of any one wall before it had been wired.

Low-ceiling lighting

Lighting our new rooms presented special problems. In closets the low (six ft. two in.) ceiling precluded, for obvious safety reasons, the bare bulbs normally used. We chose industrial-type steel-and-glass safety lamps, commonly called "vaportights." In these fixtures, bulbs are enclosed and protected by a steel cage or grid (see photo). Vaportight fixtures are available from electrical-supply houses, or the manufacturer listed at the end of this article can provide a list of local dealers.

The dressing room demanded adequate lighting, yet it, too, had only a six-ft.-two-in. ceiling. We used two recessed lights—Progress P 7's—equipped with Fresnel-lens trims that are flush with the finished ceiling. The 7¾-in.-deep recessed fixtures are housed inside the platform bed in the master bedroom above.

The hallway also has a relatively low (seven foot) ceiling, which prevented us from using track lights or hanging fixtures. This ceiling is framed with 2×6s that provide a cavity adequate for three Progress P 6 recessed lights. These shallow housings are only five inches deep. They're fitted with step baffle trims and reflector floods to light artwork on the hallway walls.

Next month: bedroom built-ins. PS

MATERIAL SOURCES

Casement windows: **Bogert & Carlough**, Box 2444, Paterson NJ 07509. Recessed lights: **Progress Lighting**, Erie Ave. & G St., Philadelphia PA 19134. Sliding-door hardware: **Stanley**, New Britain CT 06050. Vaportight fixtures: **Rab Electric Mfg. Co.**, 321 Rider Ave., Bronx NY 10451.

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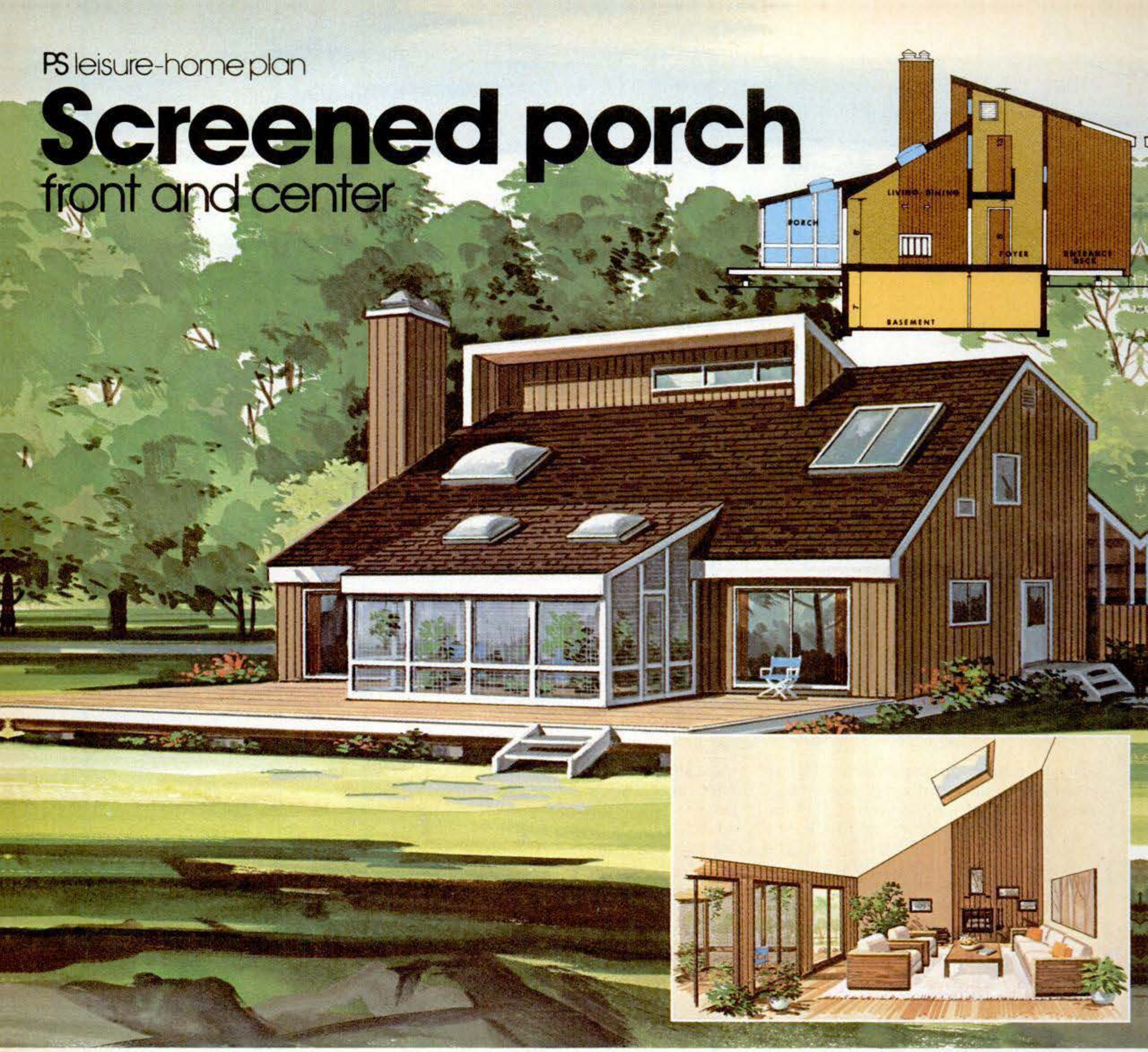
PS leisure-home plan

Screened porch
front and center



Boat trailer
you can build

After years of creating wooden boats like the Pocket Cruiser [PS, Feb.], we've finally designed a wooden trailer for towing them. Our trailer's chassis is considerably stiffer than a comparable commercially made metal one. Yet the wooden trailer is light for its rigidity. The trailer also tracks well, takes corners nicely, and backs easily.

Before building the chassis, we talked to some old-timers who used wooden trailers back in the '50s to tow ski boats. To handle these 3,000-lb. inboards, the rugged trailers had a stressed frame with bent side rails.

We borrowed that idea for our trailer. But instead of

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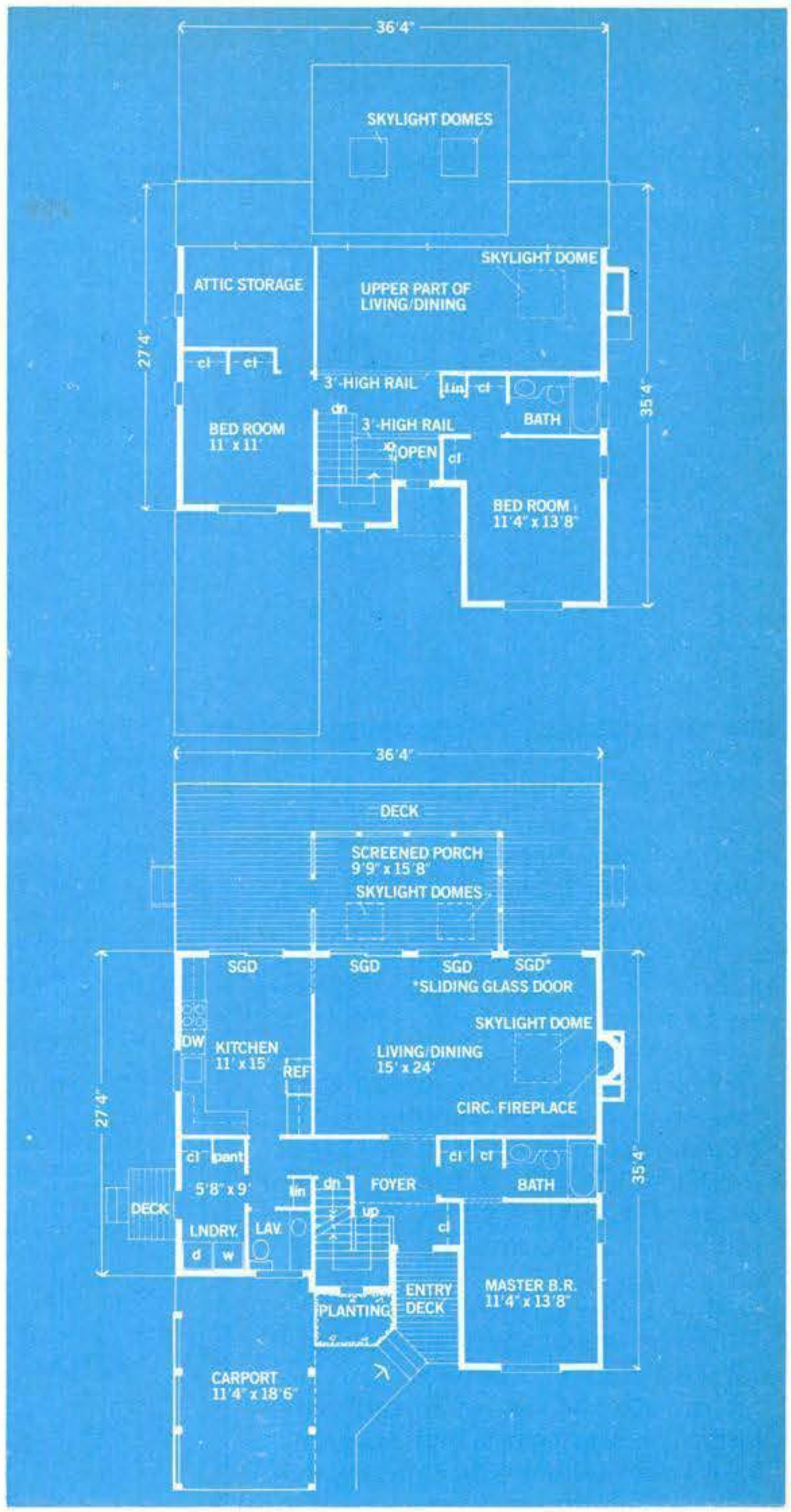
By AL LEES

It's coming back big—and it makes special sense for a leisure home, where outdoor living is the rule. The screened porch first became popular in the late 19th century as a civilized way to enjoy cooling breezes without frying yourself in direct sun or becoming a meal for flies and mosquitoes. But in the '50s the porch moved around back to become a patio. Only now are prospective homeowners beginning to realize what they've been missing.

Architect Samuel Paul has placed a screened porch front and center in his sleek new design for our series, surrounding it on three sides with an open deck. He's brought in even more of the outdoors by spotting two skydomes in the porch roof. Note, too, in the floor plan at right, that he's kept the kitchen close, since most meals will doubtless be enjoyed on this porch.

Ideally, the porch and the window walls that flank it should face south. If hot sun is likely to be a midsummer problem, cover the porch with one of the new solar screenings that bounce back solar heat—such as Phifer's Sun Screen or Gila River's Sundowner. There are also special shades for the skydomes. But in standard climates, those domes prolong the use of the porch into late fall and early spring. Direct heat gain through them and the sliding glass doors will cozy up the indoors, too.

The porch is only one feature of this house. Standing just inside the entry, you can glance up to the full two-story height. Then you see the second-floor bridge that creates a normal eight-foot ceiling for the foyer and connects the upstairs bedrooms. Beyond, as you enter the great room, your eyes sweep up again to a ceiling that soars to 17 feet, pierced with another, larger skydome. Daylighting the upper bridge is a strip of clerestory windows. The master bedroom, with its own bath, enjoys the convenience and privacy of a first-floor corner. PS



How to order your plans

One set of detailed, professionally drawn blueprints for this house is $95; five sets (for construction, financing, obtaining permits), $135. Specifications and energy-saving brochure included at no extra cost. An additional mirror-reverse print can be ordered for $15, materials list for $20. Address orders or queries to Homes for Living, Inc. (specify Cumberland Plan), 107-40 Queens Blvd., Forest Hills, N.Y. 11375. Add $5 to all orders for postage and handling; allow three weeks for delivery.

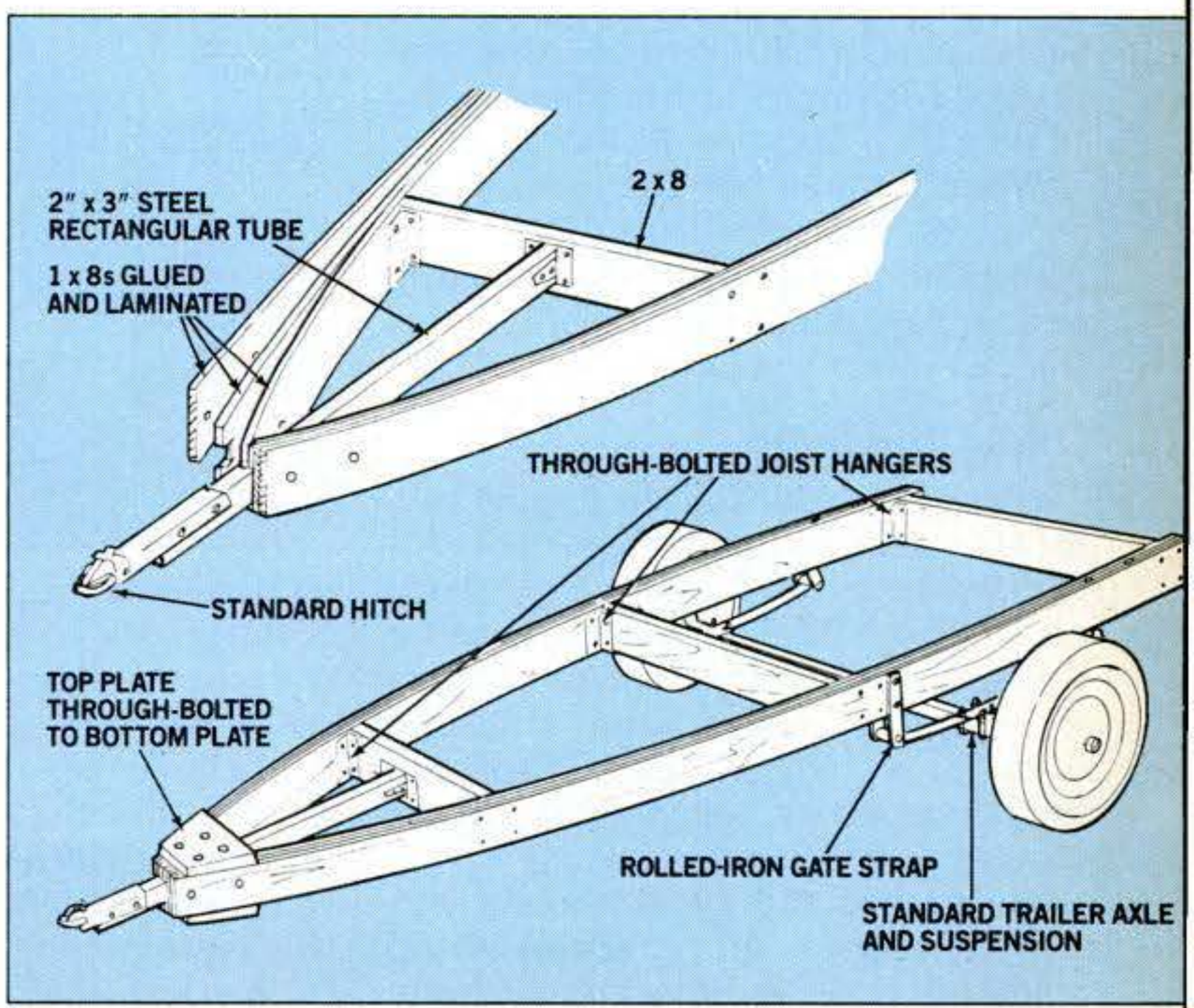
trying to find perfect 3×8s and bend them, we laminated the rails from 1×8 stock (see diagram, right). This made bending easy, and the three layers make a stiff rail.

To stiffen the chassis, we attached all cross members with standard, heavy-duty joist hangers.

The only design problem was how to make a really rugged tongue and hitch. For this, we chose a steel beam (inset, left). The beam extends from the first cross member through the chassis front. There it's through-bolted to the frame to stiffen against yaw stress. The rails in turn are sandwiched between top and bottom plates and through-bolted for pitch stress.

We mounted the chassis on a brand-new, standard trailer suspension that cost us $250. One assembled from junkyard parts would work as well. The chassis cost us about $230. (Plans cost $5 from Stevenson Projects, Dept BT5, Box 584, Del Mar, Calif. 92014.)

We knocked this trailer around for a whole season and found just one disadvantage: It floats. That means you've got to move the boat onto it fast when leaving the water. But we think the trailer's strength and light weight compensate for this minor glitch.—*Peter Stevenson*



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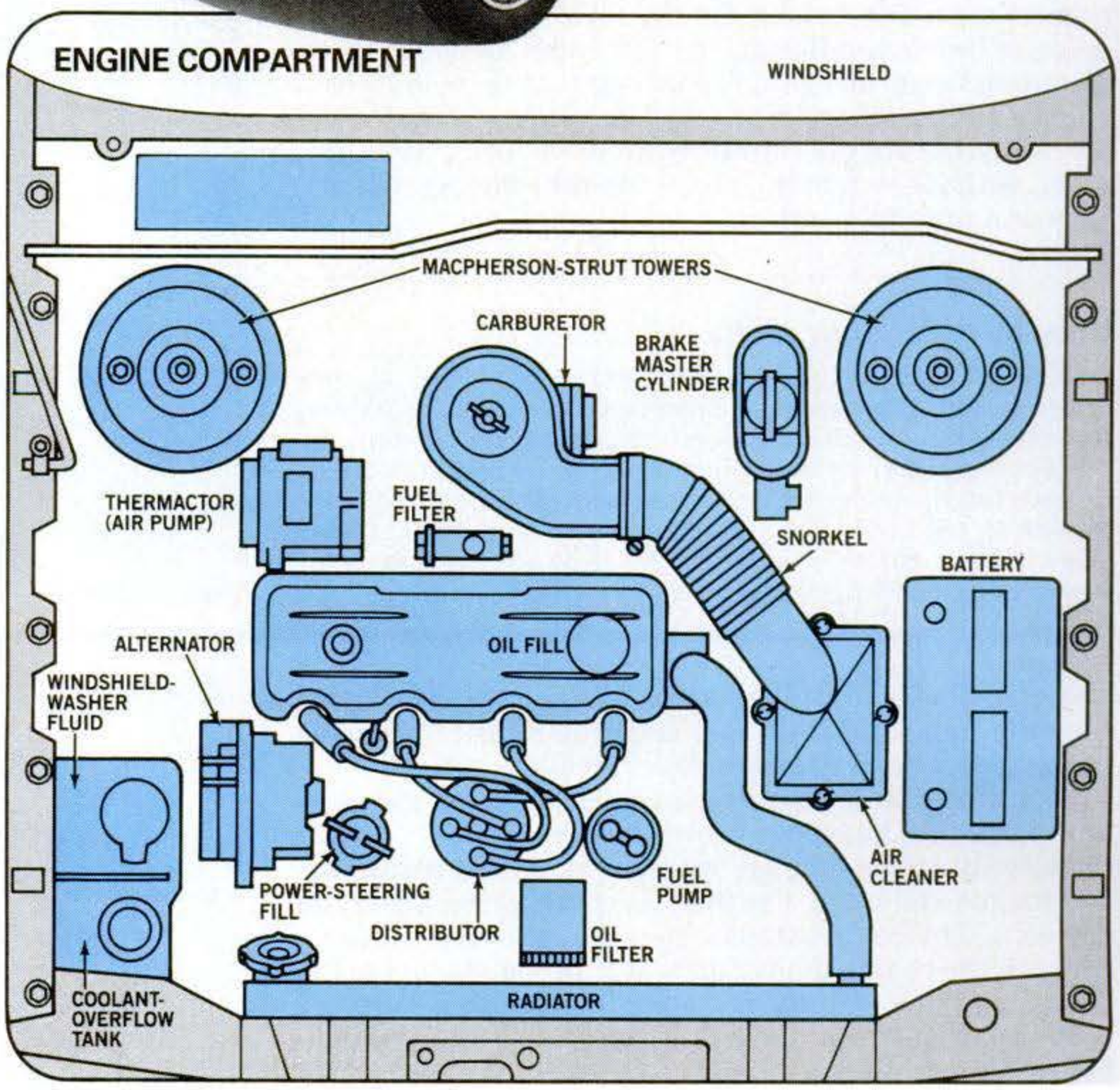
THE THINKING MAN'S GUIDE TO CAR MAINTENANCE

By JIM DUNNE
DRAWINGS BY RUSSELL VON SAUERS

With the new Tempo/Topaz, Ford aims at 1983's **simplest servicing**



Bob Bunnell is the kind of guy you like to have on your side when things go wrong. He's good with his hands, thinks quickly on his feet, and is not afraid to roll up his sleeves and pitch in. And, though you probably haven't heard of him, if you own a Ford product, Bob may have already fought a battle or two on your behalf.

"My job is to keep the design engineers from going off the deep end," Bunnell explained when I visited him recently at his office-garage in Ford's Service Research Center near the company headquarters in Dearborn. "Before new models go on the assembly line I check them out from the customers' standpoint and suggest changes."

Bunnell, a 10-year veteran of Ford's design and service branches, is proud of his work and quick to point out his successes. Ford's newest cars, the nearly identical mid-size Ford Tempo and Mercury Topaz sedans, will be in showrooms within two months and are good examples of what he is doing to help.

When I toured his garage, he had a prototype Tempo rolled in for a close inspection. Here's what I found in the engine bay, under the car, and inside the passenger compartment.

Under the hood

"Let's take a look at the engine bay, for starters," Bunnell suggested. "All frequently serviced under-hood items are yellow. These include the caps for the power-steering pump and washer-fluid reservoirs, radiator fill, and even the crankcase dipstick. You can find them easily, and they're clearly labeled so you can't go wrong."

Tempo has the usual translucent-plastic bottles for checking fluid levels in the radiator, windshield washer, and brake master cylinder.

During the inspection, I pointed out one potential source of under-hood confusion. The radiator-overflow bottle and wiper-fluid reservoir are molded into the same plastic jug. A partition divides the two. I suggested that some owners may put coolant in the wiper bottle.

"We lost that one," he admitted. "But it will be fixed in the 1984s. We're moving the wiper-fluid reservoir to the cowl position, just below the windshield."

For V-belt tightening there is a small depression in the alternator bracket, which seats a lever used to lift the alternator against the pressure of the belt. This holds the mechanic's lever in place without slip-

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ping. In addition, a flange on the alternator bracket lets you use a pair of large pliers to squeeze the alternator up against the belt without resorting to the lever technique.

A unique adjustment tightens the V belts for the air conditioning, power steering, and alternator. Metal fingers, like a ratchet gear, can be levered upward with a screwdriver to move the belt-driven accessories into tension. Then an open-end wrench can tighten both the pivot and clamp bolts in place.

On an engine loaded with power options, the problem with pulleys and pumps may look nightmarish. But taken a step at a time, you can get accessories off and on with only a moderate amount of work. In Tempo, three belt-driven components are stacked on the front corner of the four-cylinder engine. The alternator is on top, power steering in the middle, and air conditioning on the bottom.

The alternator comes off easiest: Remove the pivot and adjustment bolts, and lift up.

For power steering you have to take off the three bolts that hold the pulley in place, then three more, hidden behind the pulley, that hold the pump to its bracket. Disconnect the pressure and return lines, and it's free.

You can snake the air-conditioning compressor out the bottom after removing the four bolts that hold it in its bracket and disconnecting the intake and discharge hoses.

The fire-wall side of the engine holds the belt-driven thermactor air pump on top and the water pump on the bottom. It's easiest to remove the water pump from below. It is held in place by three bolts that attach it to the engine block. The V belt must be loosened and the radiator hose disconnected, as well. So much for the messy stuff.

Changing the air filter or oil filter should rank among the easiest of moderate-difficulty jobs. The box-shaped air filter is up front, near the battery. Its cover is held down by four screws that have slotted hex heads. They can be removed with the edge of a dime, a screwdriver, or a small wrench. The oil filter is even easier. You reach down in front of the engine from above and twist it off, using both hands or a band wrench.

Carburetors are becoming more tamper-proof as auto makers seek to ensure that emissions remain within government standards. Thus you're supposed to ignore the idle-adjustment screw on the Tempo carburetor. It's preset, so it shouldn't need service during normal use.

Like GM's cars, the new Fords have an on-board computer diagnostic feature. By probing a red connector located at the rear of the engine compartment with a paper clip and an analog voltmeter, you can tap into the microprocessor's memory for stored trouble codes. (Refer to the factory manual *before* attempting this procedure.)

Spark plugs and the ignition distributor are placed in the clear and up front where they can be serviced easily. The distributor is a lifetime design and another important part of Ford's computerized system.

Bunnell points out a thoughtful maintenance design in the headlights and turn-signal lights. Both bulbs can be removed from outside the car with only a Phillips screwdriver. Taillights are even easier to replace. Just open the trunk, reach down inside an access hole behind the taillight, and twist out the old bulb, twist in a new one.

At this point in the walk-around, Bunnell put the sample Tempo up on a hoist.

Under the car

Moving underneath, he showed me five pleasant surprises.

Ford made some major design changes underneath the engine that make starter-motor servicing easier than ever. The engine-oil pan is now an aluminum casting (to stiffen the engine-transmission connection). If you peek up under the front bumper you'll see that the starter motor is handy and clear of obstructions. Just remove three bolts and you can have the old one out and a new one installed in a matter of minutes.

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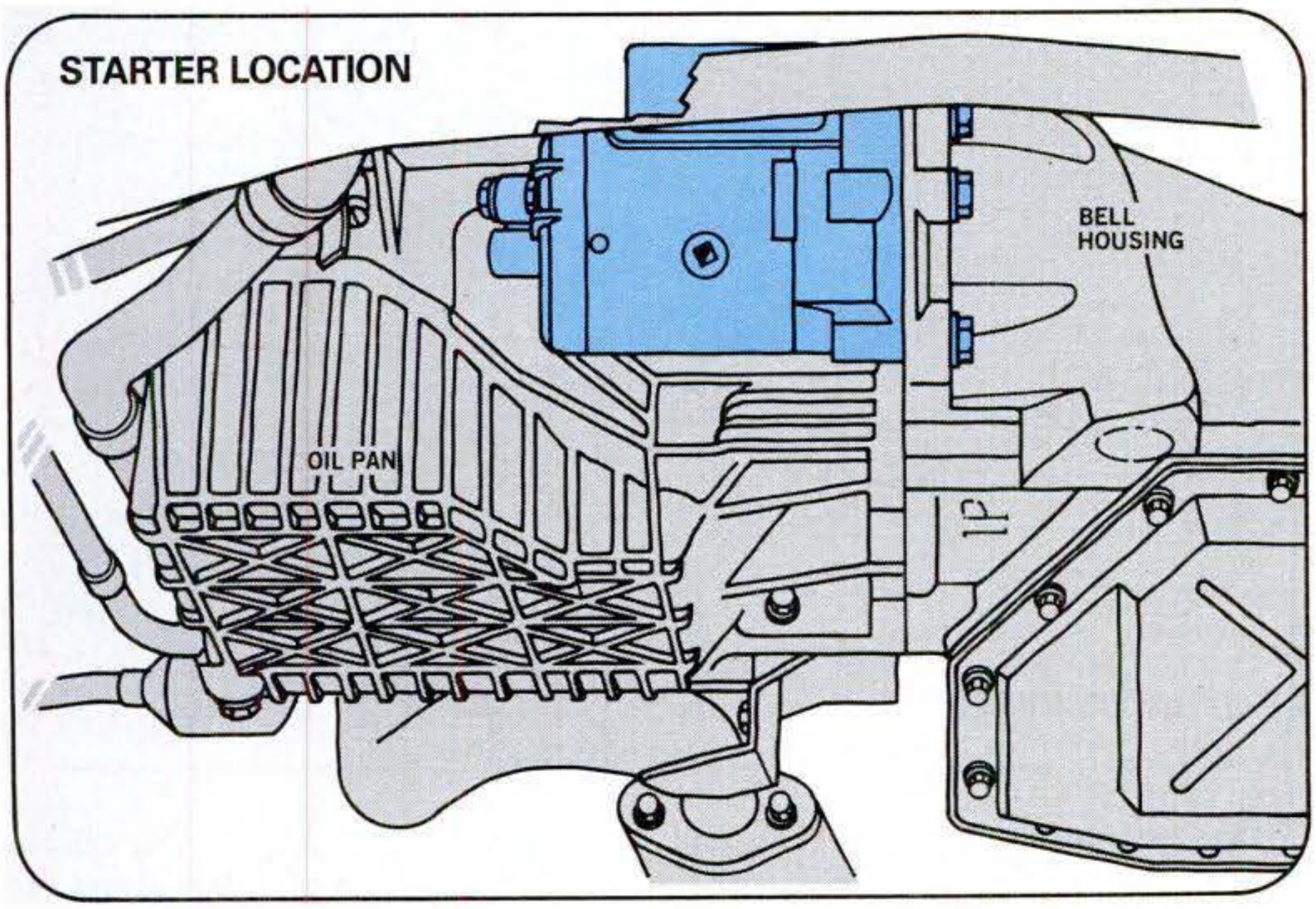

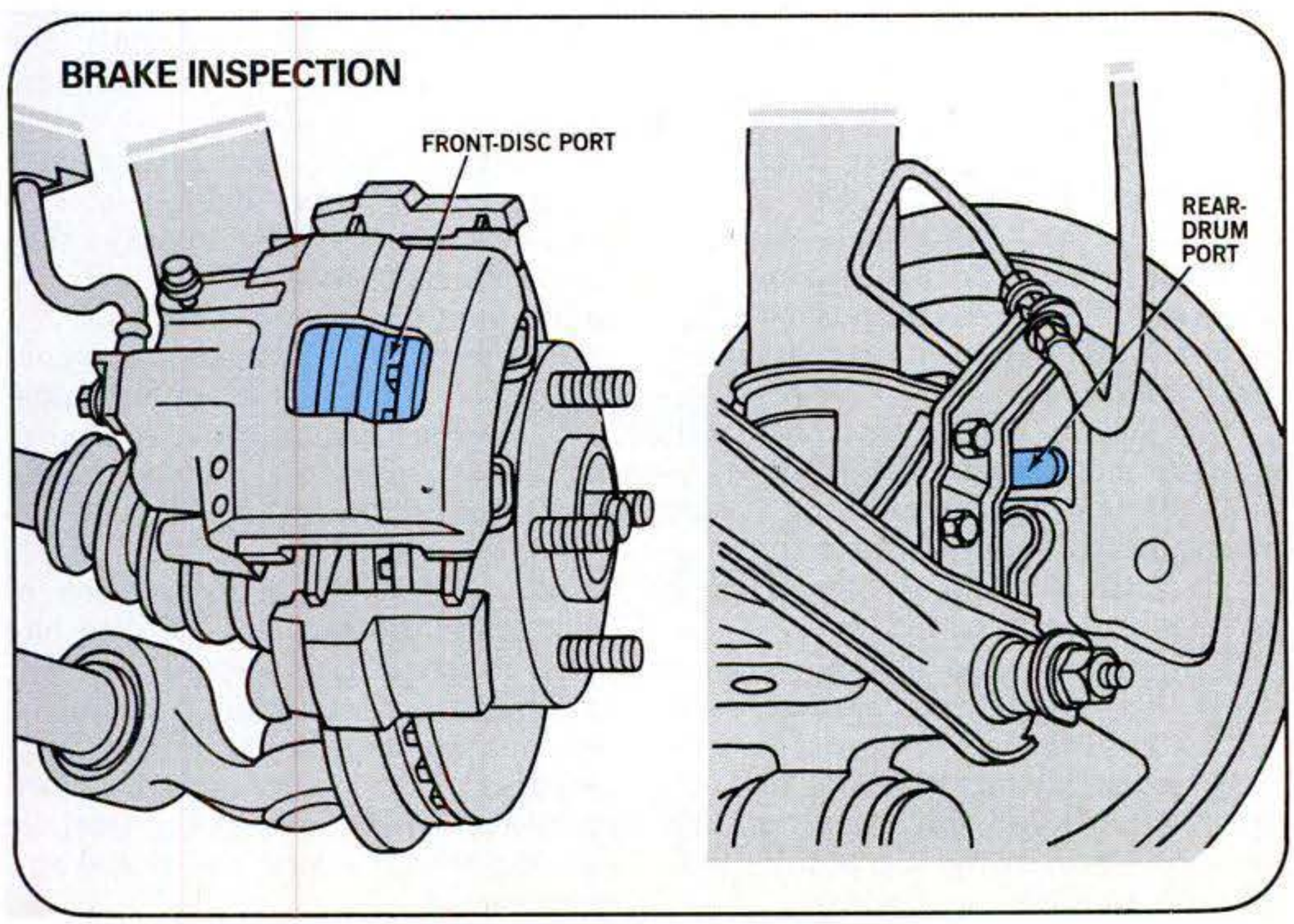

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While you're looking down there, take a glance at the radiator petcock. It has a built-in wing nut for draining, plus a nipple at the side that will take a ⅜-in.-ID hose you can use to save the coolant when draining or to divert used coolant to a waste pan.

Checking the condition of the disc pads and drum shoes is easier on these new models, too. For the discs, remove the front wheel. Look through a peephole in the front of the caliper to get a peek at the thickness of the pad. There's no need to remove the hub for a look-see. Checking the brake shoes on the rear is even easier. But you have to get under the car to look through the inspection hole in the backing plate. The hole is covered by a rubber plug that can be pulled back with your fingernail. This gives you an end view of lining thickness.

The exhaust system looks like something that anyone could tackle on a Saturday morning. The exhaust pipe, muffler, and short tailpipe are suspended below the floor pan by three hangers. Simply push the hangers out of their rubber holders, and you've freed most of the system. Two bolts at the rear of the catalytic converter form the only link that must be broken with a wrench. And you don't have to snake the pipe up over the rear axle. All the exhaust piping is below the chassis, going from the converter to the tailpipe in one plane.

As for wheel adjustment, there is virtually none to be made.

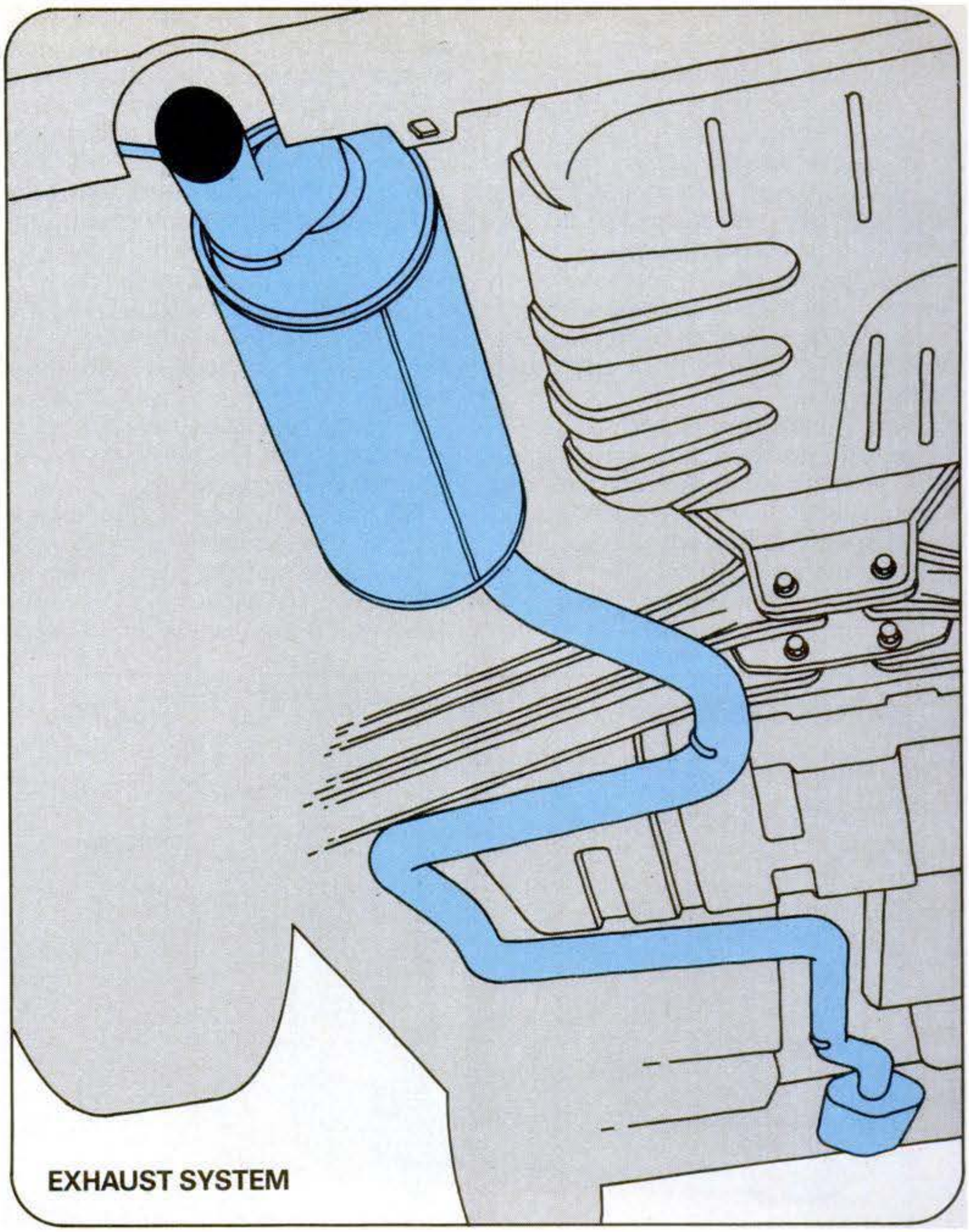
"The only adjustment to the front wheels is toe-in," advises Bunnell. "I think you should take the car to a shop for this. You're talking about $20 to check it and you can be fairly certain they will do it right."

The bad news under the car comes with the shocks and the transmission. Tempo/Topaz has MacPherson-type suspension on all four wheels; a spring-compressor tool is needed to get the strut cartridges out and in.

If the transmission clutch wears out on your Tempo/Topaz, you definitely have a major extraction-installation chore. In the flat-rate manual it's figured at about 3½ hours. That's for a skilled mechanic working with special tools and transmission-removal equipment. A major problem here is that the whole transmission has to be dropped out from underneath. It's a tough, possibly dangerous job for an unskilled amateur. "I don't think I'd want it on my chest when I crawled from under there," warns Bunnell.

Inside the car

I found pleasing results inside the passenger compartment—with one major exception.



"You've got to be kidding," I chided Bunnell, hunkering down to peer up under the dash.

"I wish I were," was his only comment.

The fuse box is hidden under the instrument panel to the left of the driver. To get a look you have to peer up from the floor at the driver's feet. Even then, the light is so poor that it's difficult to read the fuse markings or even see which one is burned out. This is a definite step backward in owner maintenance.

"But look at this," crowed Bunnell, quickly changing the subject by opening the glove compartment. "Just push the two hinges toward the middle and the box drops down. There's the heater motor."

Sure enough, the fan motor is in clear view from the passenger seat, with plenty of space around it for getting hands into any repair or replacement job. It's probably easier to work on there than in the old position under the hood.

Ford has positioned the radio speakers in the top of the panel for best acoustics. Just pry out the covering grilles with a screwdriver, remove the speaker screws, and pull the speakers straight out. No problem here.

Bunnell, whose job also includes telling Ford/Mercury dealers how to prep new cars for delivery, says that the trend to front drive and smaller cars makes his job more difficult.

"Servicing the new models presents three special problems," he explains. "The tools are different; we're changing to metric fasteners; and you have a more constrained area [under the hood] to work in."

Add to that the sophistication of electronics, and you get a mixed bag of do-it-yourself opportunities. But there's still a broad middle ground for the amateur mechanic, as the Tempo/Topaz aptly demonstrates. Shrewd maintenance designs make certain jobs easier than ever for pros and amateurs alike. PS

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STORAGE from SCRATCH

Child's hideaway

Private nook has storage for games and a desk for drawing and homework

By PAUL LEVINE
DRAWING BY CARL DE GROOTE

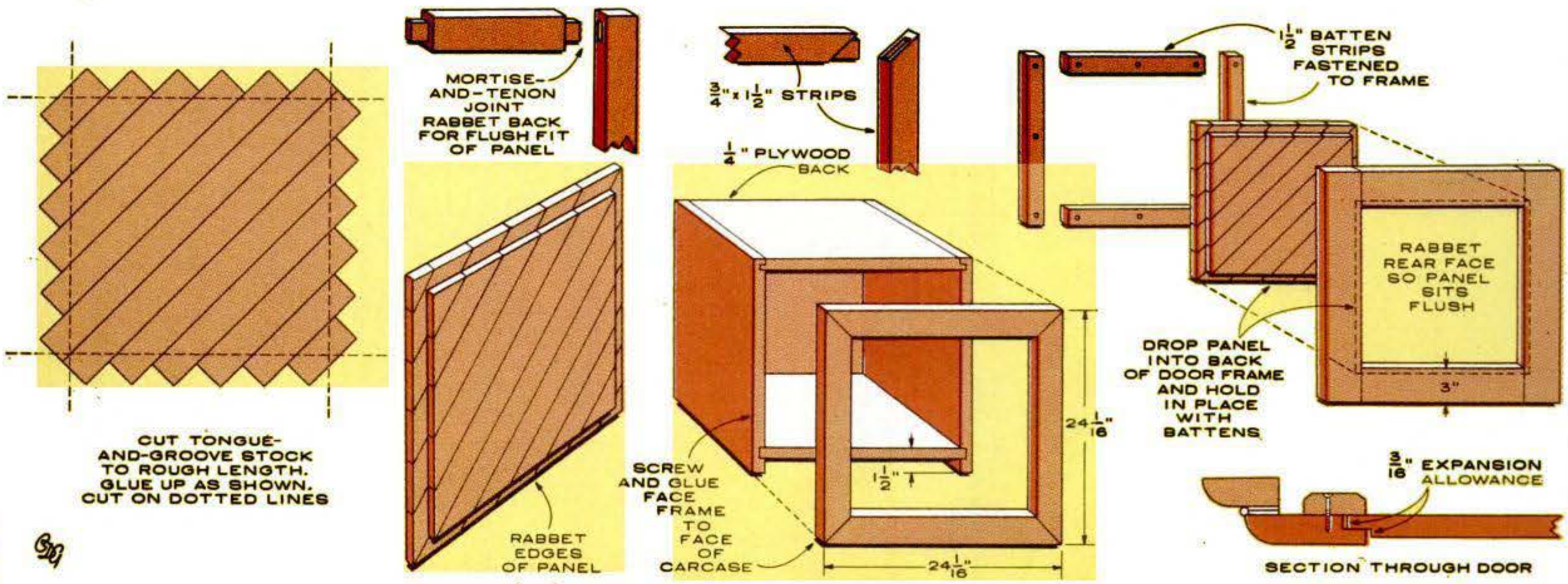
Everyone needs a special place to get away from it all—children, too. With just a little shopwork and imagination, you can create a child's hideaway in the most cramped of homes. The cabinet, desk, and bulletin board I built for my daughter Carrie are designed around the theme of trees and flowers. They give her a quiet, cheerful place to play, study, and store her little-girl treasures.

I began with a basic plywood box for the cabinet (most dimensions are unspecified so you can adapt the design). The top, bottom, and sides meet in tongue-and-dado joints; the thinner back fits into grooves in each piece. The box is raised a few inches off the floor on a black-painted square base.

The front face and door of the cabinet were made using some richly textured butternut wood that I had available. First I made and permanently attached a mitered frame to match the outside front dimension of the box. The door itself is a multilayered assembly: Its frame of butternut strips is mortise-and-tenoned to stand up to the strain it will get in use. The inside back of the frame is rabbeted (before assembly) to receive the door panel. I made the panel from tongue-and-groove stock glued up at a 45-degree angle and cut off square. The front edges of the panel were rabbeted back 3/16 inch more than the frame rabbet to allow for expansion. For the same reason, I didn't glue the panel in but secured it with battens. Assembled, the slightly recessed panel makes an ideal setting for an applied design.

Next came the work surface: particleboard cut to fit the corner, covered with vibrant-green Wilson Art laminate, and finished with a molding strip on the visible edge. It is supported at a height of 28 inches by wood strips screwed to the cabinet top and walls. An inch of space between the cabinet and work surface allows for storage of artwork. For more storage I hung particleboard shelves.

No child's room is complete without a bulletin board. I covered the entire wall over the desk with 1/4-inch cork mounted with countersunk nails and trimmed around the edges with butternut strips. The flower is made from the same cork. I cut about 100 identical petals and arranged them in five rings on the floor. Then I painted them, using solid yellow for the inside ring and adding more and more blue as I moved outward. To mount the blossom, I ran concentric circular beads of adhesive and positioned each petal with a finishing nail. PS



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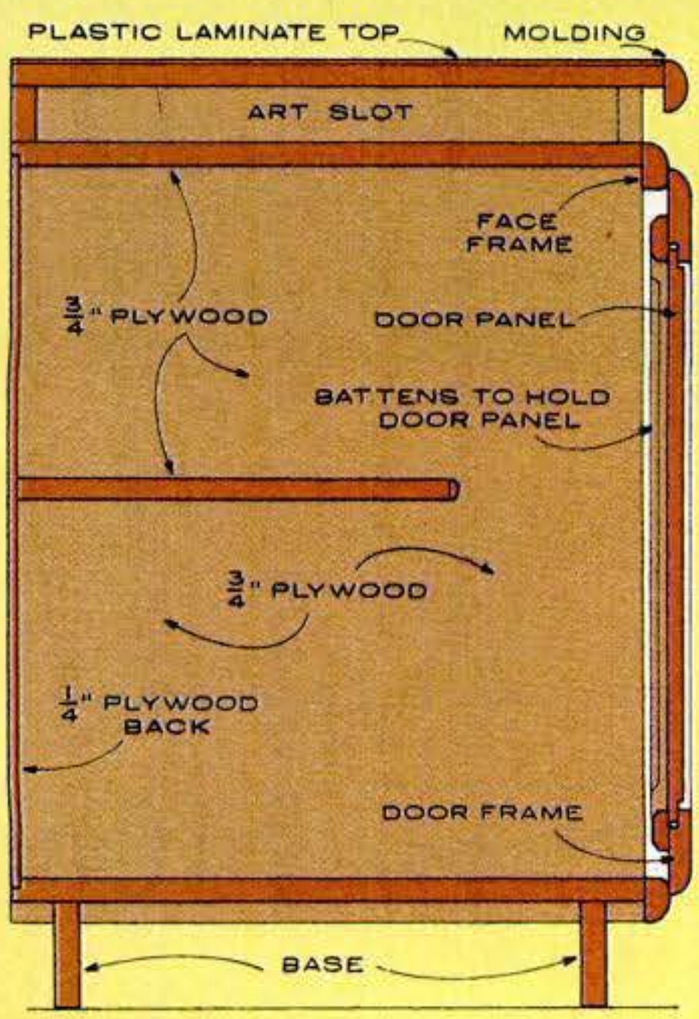

Carrie's inner sanctum combines practical storage with appealing design. Warm butternut, plus such decorative features as the free-form tree and cork flower, disguise this project's humble origins—a plywood box and particleboard shelves.

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THE STOCK TRUCK WITH GUTS ENOUGH TO FINISH TH
IS AVAILABLE THROUGH YOUR CHEVY DEALER NOW

On November 3, 1982, a Chevy S-10 Pickup—right off the assembly line—challenged the famous Baja 1000. It's the longest off-road event on the continent, running the length of the Mexican Baja peninsula. Over 985 miles of rocks, sand, dust and heat. A course so tough that even many specially equipped trucks did not finish.

But the new-size S-10 4X4, with optional V6 engine, the revolutionary new Insta-Trac 4-wheel drive, and optional Off-Road Chassis Package, entered with no special equipment except for safety items required by the sponsor In fact, it was the *only* totally stock truck to enter And for 37 hours. the S-10 took everything the

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ERS BAJA.

BAJA 1000

Baja could dish out.

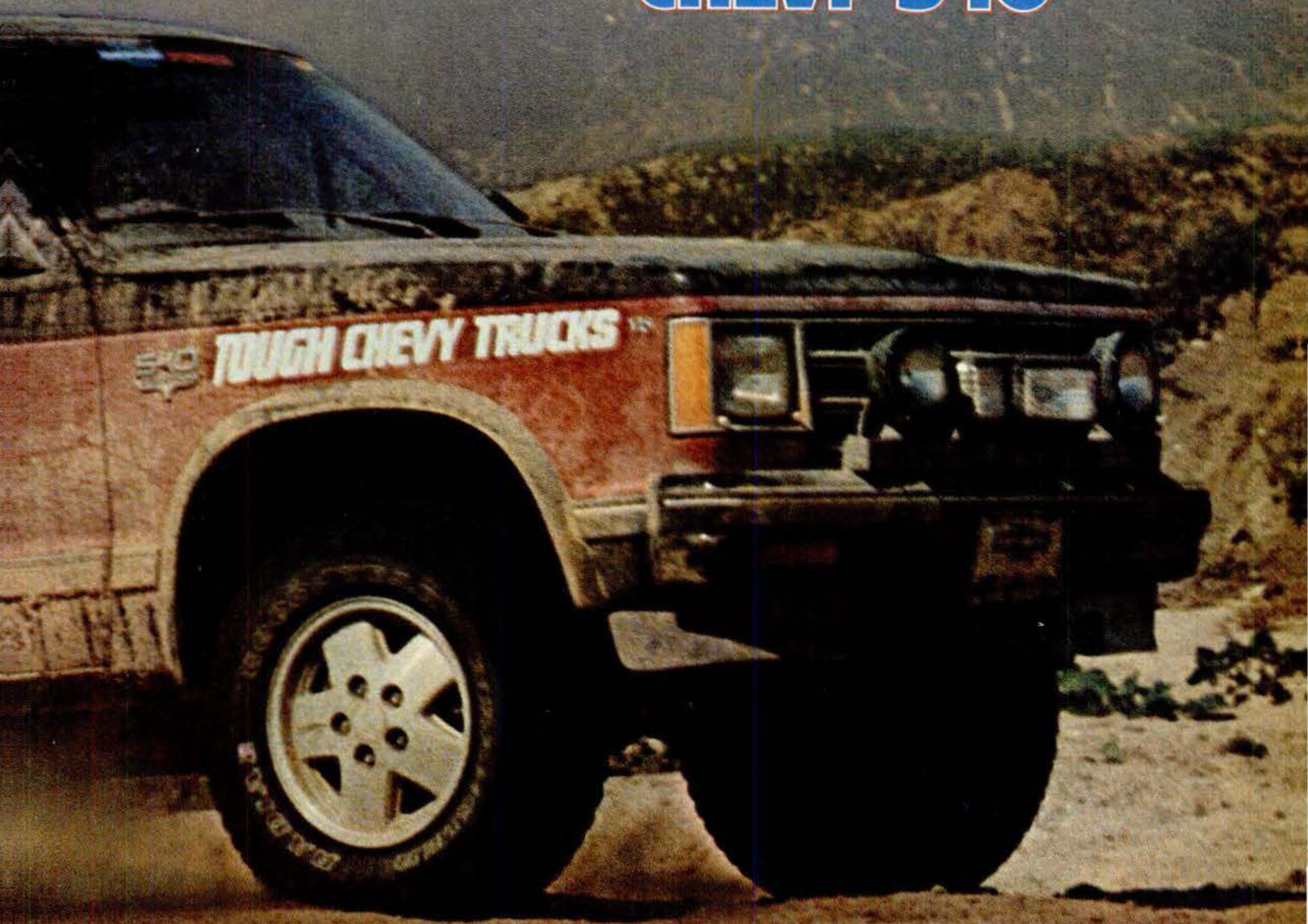
Like all entries, the S-10 took its share of punishment. But at Baja, to finish is to win. Because in a field of 135 entrants, 70 could not even complete the course.

We think conquering the Baja says a lot about the way Chevy S-10s are built because you can buy a pickup just like it—the one that conquered Baja—at your Chevy dealer's now.

Some Chevrolet trucks are equipped with engines produced by other GM divisions, subsidiaries, or affiliated companies worldwide. Ask your dealer for details.

Let's get it together...buckle up.

CHEVY S-10



ARE TAKING CHARGE

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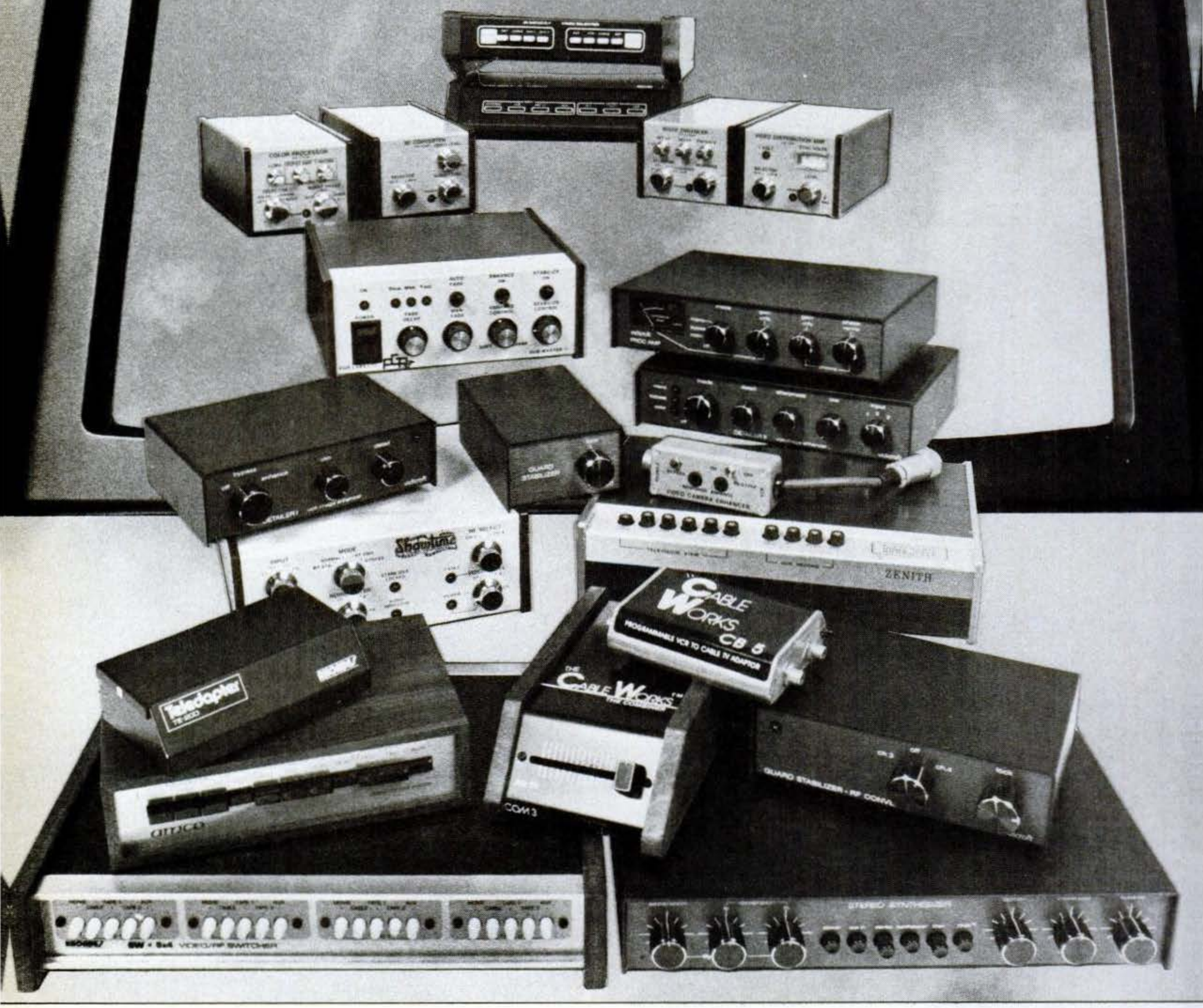
Popular Science ELECTRONICS

Switchers, enhancers, amplifiers, synthesizers: The new video add-ons



Controlling all your new video gear needn't be a wiring nightmare

By WILLIAM J. HAWKINS
PHOTOS BY GREG SHARKO

I had it all worked out: To watch regular TV I connected the blue wire to the blue connector. To watch a videotape I merely exchanged the blue wire for the purple cable and added a jumper between those two orange jacks. Watching a videodisc was just as easy as long as I remembered the red line could only be connected when its antenna switch was in the COMPUTER position. But there was one problem: I was only able to watch reruns of "Mission: Impossible."

If your TV is like mine, it's become an outlet to an avalanche of new video gear: tape, discs, games, and computers. And controlling it all has become a nightmare of fumbling with cables, connectors, and tiny switch boxes that

Continued

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YOUR CHOICE FREE

Don't be left out of the Phone revolution. Now you can plug in any of the new modern phones with modular phone plugs just about anywhere with one of the bonus adaptors below when you buy the Phone Thrustor automated telephone.

Modular Phone Plug-If you already have modular phone plugs you can plug in the Phone Thrustor and start dialing. But, don't worry about filling up your plugs, because the adaptor pictured to the right turns one of your plugs into two. So, now you can plug in an answering machine or a cordless phone into the same jack as the phone.

Four Prong Plugs-If you've got 4 prong plugs, no problem. Just plug this handy adaptor into one of them and it will instantly covert it into a new modular phone jack.

No Jacks At All-If your house is still 'hard wired',(no jacks) you don't have to be left out. Most of the country uses the same 4 color coded wires to hook up phones. There is a red, a black, a green and a yellow wire. All you do is unscrew your current box and match your four wires to our identically colored wires. It's best to check with your phone company, but just about anyone can do it in less than 5 minutes with just a screwdriver. There's no soldering, no thinking. Just match the colors, tighten the screws, and start dialing.

Phone Thrustor

It's lightning fast. It speaks real rotary and real Touch Tone®. Plus, it's got an elephant's brain (with battery back-up) that remembers up to 24 numbers. And now you can install it just about anywhere.

Push button phones aren't new, nor are automated dialers. But, the Phone Thrustor combines the best of both into a powerful new tool that will save you time and money.

And, with Phone Companies making you buy or rent your old dumb phones anyway, why not skip their monthly service charges and get the latest in sound quality, modern good looks and automated features for your home or office.

NEAR AND FAR

Whether you call across the street or around the world you'll find that this phone puts you in complete command.

First the sound. A high quality condenser microphone just like you'd find in a good tape recorder lets the person you're talking to hear you loud and clear.

And, you'll hear them like never before. Instead of the old diaphram 'thing' that's been in phones for the last 20 years, you get a mylar® HiFi speaker just like you'll find in the best stereo headphones for real Hi Fidelity telephone conversations.

THE BEST PART

But the nicest part of all are the push buttons. Once you've started using buttons you'll hate dialing the old way.

The Phone Thrustor has a switch right above the keyboard that lets you select real rotary pulse (P) if you currently have rotary dial phones or true Touch Tone® (T) if you already have push button phones.

So, with the Phone Thrustor you'll have a perfect match to your personal phone line today or in the future. And you'll always have the ease of push buttons.

The switchable pulse and tone are especially nice if you live in a rotary dial area but would like to save big dollars on your long distance calls by using the super discount services like MCI and Sprint. You can dial in on pulse, then switch to Tone.

PROTECTED MEMORY

The Phone Thrustor will dial all your normal calls automatically in about 1 second by using its automated up to 24 number memory. You can program it to dial your family, your office, or your friends. You can also program it to give the complicated Sprint and MCI codes so you don't have to memorize and dial them each time.

In addition you'll use the memory in the future, for more services like automatically paying bills and banking.

And, don't worry about forgetting. The phone itself is totally powered by your phone line, and needs no additional power. The memory is protected for over a year by two easily replaceable calculator type back-up batteries (included). So, forget power failures. And, you can move it from room to room, or between your home and office without losing the memory.

LOADED

The Phone hangs up automatically whenever you set it down. Or, with the included wall adaptor, and extra-long 11' coiled cord, it becomes a convenient wall phone that reaches just about anywhere.

The Phone Thrustor has instant save-a-number. If you get a busy line, just push the (S) button. Then you can call as many other phone numbers as you like before pushing (R) to retry the busy number.

The Phone Thrustor has an electronic mute button. Touch it once and a red LED lights to show that it's activated. Touch the button again and you're back on line.

This phone is built more like a fine piece of stereo equipment than a phone. And, it carries a full one year limited warranty from Code-A-Phone. It's a phone you can trust and name you can trust.

INSTALL ANYWHERE BONUS

In the United States there are really only three types of phone connections: modular phone jacks, four prong phone jacks, and hard wired.

If you already have the modular phone jacks, just plug the Phone Thrustor into any unused jack. But, don't worry if all your jacks are used, because we give you a free duplex adaptor plug that turns one of your jacks into two jacks.

4 pronged plugs? We give you an adaptor that changes it into a modular jack.

But don't despair if you don't have either type of jack. Now it's all easy. No matter where you live, you'll probably find your phones are connected using the same 4 colored wires. There's a red, black, yellow and a green wire. You'll get a free surface mount box that will turn your hard wired system into the new modular phone jack.

It just takes a screwdriver and 5 minutes. There's nothing to solder, nothing to figure out. Just match our colored wires to yours and tighten the screws. A 70 year old grandmother should be able to do it in less than 5 minutes.

TRY THE PHONE THRUSTOR RISK FREE

Wait till you feel and hear the quality of this phone. Its space age styling and beautiful chocolate brown color are a great addition to any room.There's even a place for a 24 name directory of names and numbers on the back of the phone.

And wait till you try dialing a number automatically in about one second. If you aren't 100% satisfied for any reason, just return it in its original box within 30 days to DAK for a courteous refund.

To order your Code-A-Phone 24 memory switchable Pulse and Tone, Phone Thrustor risk free with your credit card, call toll free or send your check for just **$58.50** plus **$2.50** for postage and handling to DAK. CA res add 6% tax.

How to order! If you have modular jacks use Order No. 9611. For 4 prong jacks use Order No. 9612. And if you have no jacks now use Order No. 9613. We'll include the correct bonus connecting jack free.

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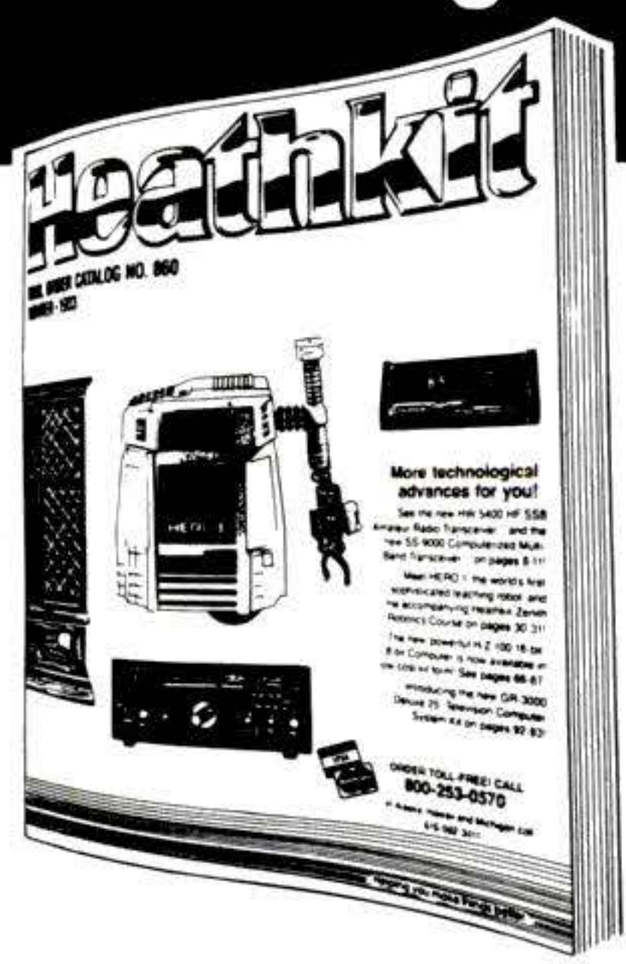

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[*Continued*]

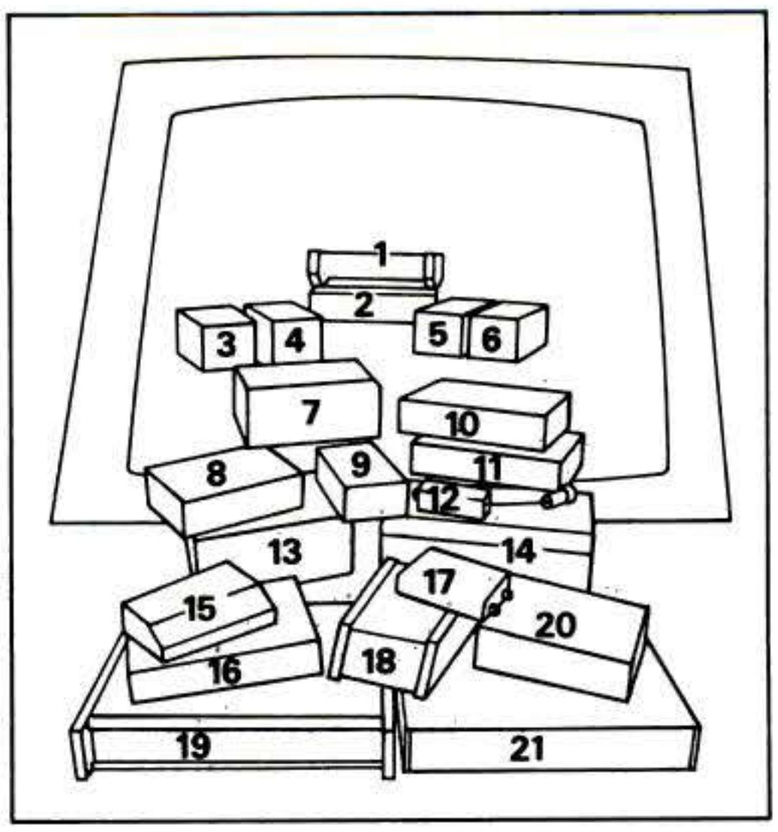
not only add to the complexity of TV watching but, worse, degrade performance.

Fortunately, there are now new video add-ons that can change all that. They're black boxes that not only give you instant push-button control over what you see on the screen but also improve picture and sound quality. They'll work with a conventional television, but they're designed to be useful with any video gear—from a component-TV system [PS, June '82] to a second VCR for editing tapes.

Prices range from $75 to well over $300, and functions range from simple to complex. You won't find one box that does everything, however. In fact, there are several distinctly different types of add-ons:

Switchers. These are boxes of push buttons that connect all components in your system. By pressing the buttons you decide which signals go where. You can watch one show on the main TV, for instance, while sending another to a second TV elsewhere in your home. At the same time you can tape yet another show for future viewing.

Enhancers and processors. These boxes electronically restore parts of the video signal. They boost high frequencies (for a crisp picture), increase video level, correct color and tint, and add synchronizing pulses to prevent picture rolling. While these boxes can be used to enhance the picture on the screen, they have even more features for dubbing—and editing—videotapes from one VCR to another.



Key to add-ons on previous page: (1) Radio Shack switcher; (2) Cable Works switcher; Video Ventures (3) color processor, (4) RF converter, (5) enhancer, (6) amplifier; (7) PGR enhancer; Vidicraft (8) enhancer, (9) stabilizer, (10) processor amplifier, (11) video switcher-enhancer; Video Ventures (12) camera enhancer, (13) enhancer-RF converter; (14) Zenith switcher; (15) Rhoades stereo synthesizer; (16) Amco switcher; Cable Works (17) VCR-cable adapter, (18) combiner; (19) Rhoades switcher; Vidicraft (20) stabilizer, (21) stereo synthesizer and noise-reduction system.

Amplifiers. They amplify and split the video signal so it can be used by more than one component in your system. The original signal enters its input jack; output jacks feed additional TV's in your home or your VCR for taping. Each component gets a maximum signal for the best picture.

Audio synthesizers. The newest boxes to arrive, these attach between the audio line of your video system and your hi-fi. The result: simulated stereo.

Must you buy several boxes to get all functions? In many cases, yes. But depending upon the model you buy—and the price you pay—some offer many functions under one cover. Here's a closer look.

Getting organized

If your finger tips are raw from unscrewing cables every time you want to watch something different, a switcher is for you. In fact, it's probably essential for anyone starting a video system. Make some simple connections, and you gain complete control over your system at the push of a button.

Generally, switchers work with 75-ohm RF lines—the coaxial cable that normally goes to the antenna terminals of your TV. On the rear of the switcher are banks of connectors. Input connectors accept the source material: Here you attach the cables from your roof or master antenna, pay-cable box, videodisc player, VCR-playback unit, video game, and even your home computer. Output connectors feed the signals to at least one TV set and a VCR for recording.

Internally wired between the input and output connectors, however, are front-mounted buttons. The Zenith Organizer, for example, has two sets of buttons. One set allows you to choose from up to six different inputs to be seen on the TV. The second set chooses one of three inputs for recording on your VCR. For example, press GAME from the "Television View" group and STV (for subscription TV) from the "VCR Record" group. Your recorder will tape a movie from the cable channel while your TV screen displays the latest Klingon war battle from your video game. Both video signals work independently—and both are instantly selectable at the push of a button.

The Organizer is a good buy at $100, especially since it uses electronic switching: The buttons you push

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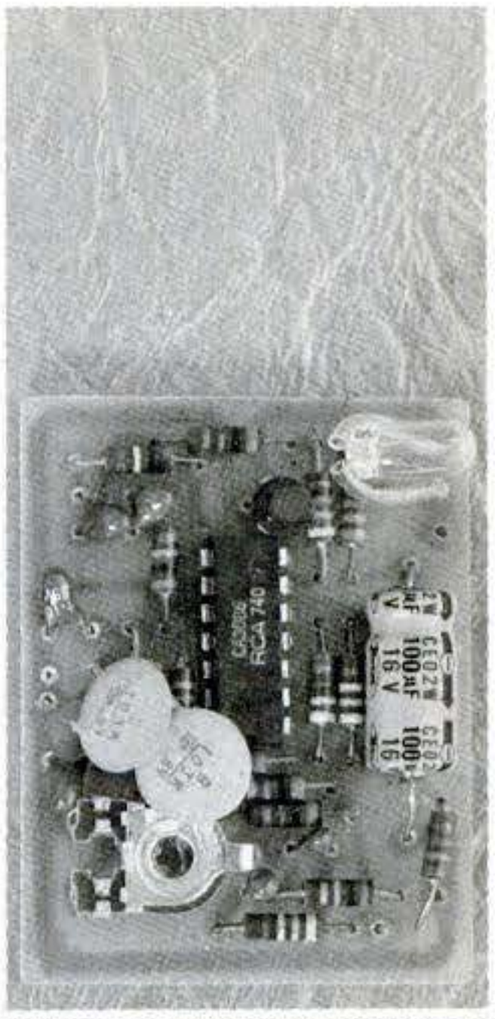

The electronic circuit board brain and heavy duty pressure meter in the Electronic Heart Decoder will give you accurate, dependable blood pressure readings.

Electronic Heart Decoder

Unravel the secrets of your body. See if your body may be scheduled to be a battleground in the next war.

Do you cheat? Think about the day of your last physical examination. Did you skip your morning coffee, skip a cigarette, and did you ask your doctor to let you relax before he took your blood pressure?

Well, if you did even one of the above, it's like cheating at solitaire. Because like your temperature and weight, blood pressure shows the condition of your body.

Some high blood pressure is related to diet. (Check your pressure after you have had something with caffeine or a cigarette). Some is tension related. (Check it at the office and then compare it with your pressure on a Sunday morning).

And finally, some high blood pressure is genetic. Only your doctor can tell you. But, remember, your doctor probably only sees you in a relaxed state.

All high blood pressure is bad because it puts an extra strain on your heart and circulatory system that can lead to heart attacks and strokes.

And high blood pressure is doubly bad because you can't tell that you have it. So, unlike a bruise or a cold, there are no symptoms that you can see. That's why it's called the silent killer!

WHAT IS BLOOD PRESSURE

Two measurements are used to measure your blood pressure. Systolic pressure is the pressure in your arteries during the time that the actual heart beat or pulse passes along your arterial system.

Diastolic pressure is the resting pressure that occurs between the beats or pulses. A pressure of 120/80 (120 systolic over 80 diastolic) is about average for most young adults. There's a chart of average blood pressures by age included with the Electronic Heart Decoder. But, you should always consult your own doctor.

TIME FOR A STETHOSCOPE??

If you can't see it or feel it how can it be measured? Your doctor probably uses a column of mercury, an inflatable arm band and a stethoscope.

Since you're probably not a doctor, the complicated parts have been automated. Just slip your arm into the Electronic Heart Decoder's pre-formed velcro cuff, and simply inflate the cuff. The rest is automatic.

The mercury has been replaced by a sensitive, dependable analog pressure meter. The stethoscope has been replaced by a combination of a microphone implanted in the pressure cuff, an advanced integrated circuit, and a flashing light.

After you've pumped up the cuff, the cuff will slowly de-pressurize automatically. When the reading on the pressure meter accurately shows your systolic (high) pressure, the light will start to flash with your pulse. The meter then moves on to your diastolic (low) pressure. When it's shown, the light will stop flashing. It's easy. It's quick and it's accurate.

EXERCISE--EXERCISE--EXERCISE

You've heard it before and I'll tell you again because I want you to be around to keep being a DAK customer, and because it's what my doctor told me.

"Drew if you expect to keep your blood pressure down, you've got to keep your weight down and make sure that you get regular exercise."

But honestly, it wasn't so much what my doctor said that got me started as the way I felt when Steve, a 37 year old slightly overweight friend of mine had a heart attack in November.

He owns a business like mine. He too works 16 hours a day, 7 days a week. And, neither of us smoke. Now we are both exercising regularly. And as his doctor says, and as I can testify to, we'll probably both be in better shape than ever.

But as long as I'm being honest about why I've started to get back into shape, I might as well also let you know that in 6 months or so, I may get lazy again.

But I hope not. I hope that using the Electronic Heart Decoder as well as my scale to measure my improvement, I'll have the self discipline to keep it up.

The Heart Decoder is backed by Biometric's limited warranty. It is powered by one 9V battery (included).

A $39 JOKE?

No, it's no joke. The Heart Decoder is a sophisticated measuring device like those you'll see selling for up to $79.

The price is so low because Biometrics happened to have 3500 extra units just at the time my friend had his heart attack and my doctor told me to start exercising. I figured it was fate and I bought them all.

The Electronic Heart Decoder is accurate, and it's easy to use. Just check your own pressure. If it's up, go see your doctor **now**. Of course you should have regular checkups either way. I also recommend that you take the Electronic Heart Decoder to your doctor and have him check its accuracy by comparing it with his own device.

If you or your doctor aren't 100% satisfied for any reason, return it to DAK in its original box within 30 days for a refund.

To order your Electronic Heart Decoder risk free with your credit card, call the DAK toll free hotline or send your check not for $79 or even $69. Send just **$39** plus **$2.50** for postage and handling to DAK. Order Number 9602. CA res add 6% sales tax.

You don't get your body on a 30 day risk free trial. So get your body outside and get it some exercise, don't smoke, and maybe lose some weight. While I may not get rich selling you this discounted blood pressure meter for $39, I may get rich if you're around long enough to buy some of my more expensive products.

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SOUNDS THAT SOOTHE...

The Marsona sound conditioner generates the primal sounds of nature—the surf, the rain, the rhythmic gushes of a waterfall. And these sounds aren't recorded— but synthesized— with the use of advanced solid state electronics.

Hospitals use sound conditioners like the Marsona to relax patients in the coronary and respiratory care sections. Controlled laboratory tests at a university sleep lab indicated that sound conditioned sleepers got to sleep quicker, slept longer and received about 50% more Delta (stage 4) deep sleep.

Marsona's all-electronic design offers several advantages over earlier electro-mechanical models: more types of sounds (2 surf, rainfall, waterfall). There are no moving parts, no tapes, nothing to wear out. And it uses less electricity than a small night light. Measures only 7×8×5".

And you can fine tune sounds to exactly your likes; from a mere whisper all the way up to a strong masking sound. With the surf you can even vary the rhythm from slow to fast to random.

The Marsona 1200 uses 'white noise'—long recognized by scientists for its ability to mask out unwanted noise that interferes with sleep, relaxation or work. We offer you the Marsona 1200 for a full 30 day money-back trial. One year warranty.

ORDER TOLL FREE

Order product #MC643. Credit card holders may use our toll-free number. Or send check for $129 plus $4.50 delivery (in California, add $7.74 sales tax).

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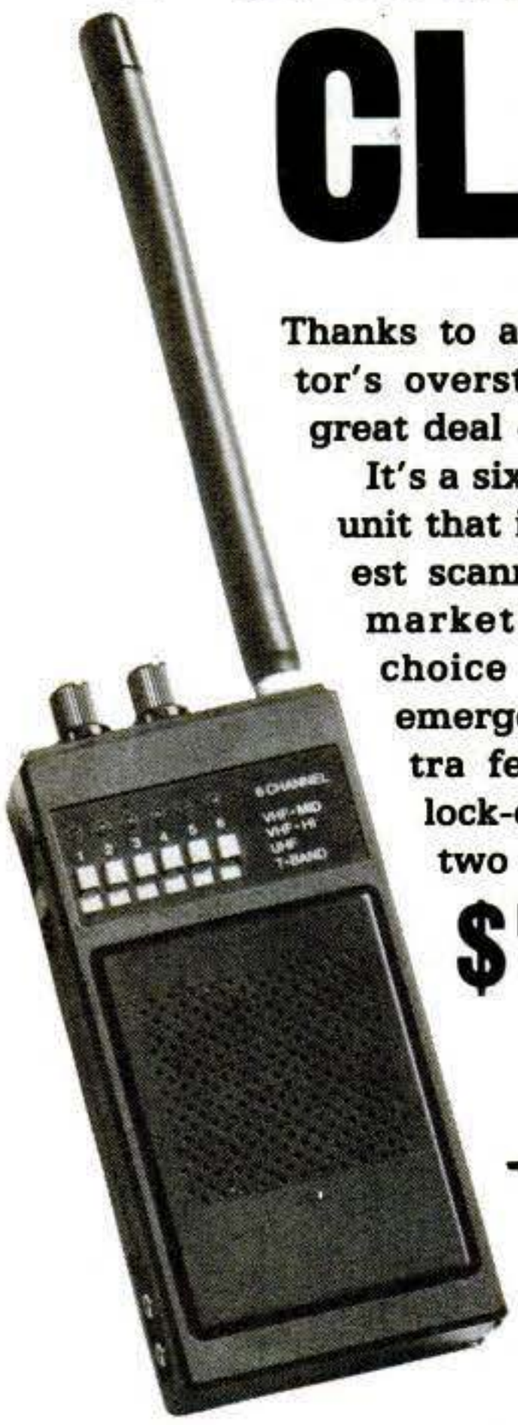

Thanks to a European Distributor's overstock, you can get a great deal on a pocket scanner. It's a six channel, three band unit that is actually the smallest scanner available on the market. You'll hear your choice of police, fire and emergency calls and get extra features like channel lock-outs, manual control, two antennas plus an AC charger/adapter. Coverage includes UHF bands, VHF high bands and mid-band.

We've taken what is already a good value and made it a steal! From the original price — the equivalent of $190 — we've lowered the price a full $110. Plus you get two frequency crystals of your choice at absolutely no charge. And, you'll have our 25 day no-hassle refund privilege so you can try it out before making your decision. Don't Delay. Supplies are limited. Call Today. 24 hrs. a day 7-days a week.

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Video add-ons

[*Continued*]

control a circuit that makes the necessary connection. Compared with conventional mechanical switches, it means a perfectly balanced, interference-free signal on all lines.

Ah, but any videophile worth his weight in channel-changing knobs has more than one TV and perhaps even a second VCR. For him, there are other units. The Amco VCC-1, for instance, controls the inputs to a VCR and two TV's—one main TV and one remote. Each TV can receive any of four inputs; you can choose from any of three inputs for the VCR. Need more? The Rhoades SW-5×4 allows up to five inputs for two TV's and five outputs for recording two shows on two VCR's. Now that's entertainment!

In general, the cost determines the number of inputs and outputs the switcher can control. But there is an exception: Select-A-View from The Cable Works. This unit has no buttons. Instead, it uses touch pads and a microprocessor to accept your commands. Push one of the first four pads and you've told the unit *what* you want; press one of the three remaining pads and the unit now knows *where* you want it. As you repeat the process with other instructions, the smart microprocessor keeps track of all your entries and feeds the right signal to the right place. The unit also displays your programming with lights, or defaults to an original setting if you've made a mistake. Of course, you pay for this sophistication. Select-A-View costs $200.

You've now used a switcher to get the RF signal containing this week's "Lawrence Welk Show" to a particular component in your system. Assuming you haven't made a terrible mistake and this is really what you want, what happens now? Once the signal passes through a tuner—in a TV or VCR, for instance—it is demodulated. The original audio and video signals are extracted; the video signal could be sent to a screen for viewing and the audio to a speaker for listening. Or instead, these signals could go to one of the new enhancement boxes.

Bo Derek: 11?

Most enhancers work on the video signal only. Their most important goal: Increase picture sharpness.

Picture detail is contained in the higher frequencies of the video signal. Unfortunately, they're the first to be lowered (attenuated) or lost when passed through cables or recorded on tape. Enhancers, however, boost the higher frequencies of the video signal. Result: The picture detail is restored . . . almost.

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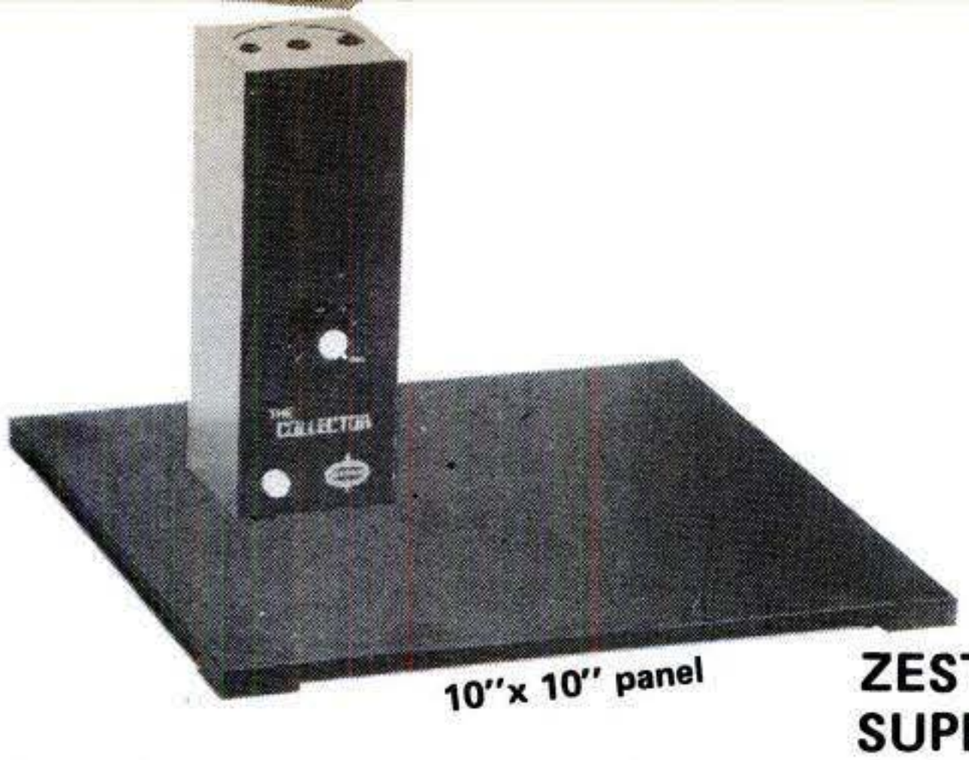

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THE COLLECTOR

IF YOU WANT CLEAN FRESH AIR OR YOU'VE UNPLUGGED YOUR POPULAR FILTER-FAN UNIT BECAUSE IT DOESN'T WORK, THEN READ ON.

Is your indoor air fresh, clean and alive? Indoor air pollution is becoming a national health hazard. Energy efficient airtight buildings are stifled with stale polluted air which includes smoke, dust, pollen, viruses, and bacteria. Most of these pollutants are so small (under 5 micros) that they are not effectively removed by common small filter-fan units. Scientific tests show that these noisy inefficent units which emit chemical "citrus" odors are more like toys, and are no match for high-powered ionizers in thoroughly cleaning the air we breathe.

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You know how good and vibrant the air feels right after a rain storm with that crisp, fresh smell? Just like in the mountains, near a waterfall or at the ocean. That clean, alive fresh air is rich in something important that is missing or greatly depleted in our urban and indoor air. The missing element is negative ions, nature's own air cleaners. *Scientists claim that these amazing active ions are of great benefit to you and can actually make you feel alive, revitalized and alert while relieving depression, headaches and allergies. Negative ions promote sound sleep, learning and healing and even make plants grow better. In addition, hospitals use ionizers in burn units to destroy bacteria and reduce pain.*

Filter fan units do not emit negative ions. The COLLECTOR, by Zestron, creates trillions of these beneficial ions every second, while giving you the best performance, value and technology in air cleaning.

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Most ionizers clean your air but leave an untidy deposit of pollutants on room and furniture surfaces near the ionizer. The COLLECTOR by Zestron takes ion technology a giant step forward by giving you superpowered ion output while depositing pollutants from your air on the collector panel. This easy to clean panel features a scientifically formulated surface that electrostatically attracts the vast majority of airborn pollutants to it rather than to the floor or walls near the ionizer.

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Some people prefer fewer ions at night. The COLLECTOR is the only adjustable bipolar ionizer that allows you to set the ion level to your personal preference. The detachable COLLECTOR allows you to place it where you want to protect desired surfaces and facilitate cleaning. The scientifically formulated surface instantly wipes clean unlike other bipolar ionizers whose porous surfaces absorb odors and unsightly grime.

AMAZING DEMONSTRATION!

Unplug your COLLECTOR and place a facial tissue on top of the collector panel, then place the ionizer unit and an ash tray on top of the tissue. Place a lit cigarette in the ash tray and watch the smoke rise into the air. Now plug it in, and amaze yourself and friends as the smoke barely rises above the ashtray and then nose-dives into and is absorbed by the tissue before it can enter the room air. This air cleaning is accomplished entirely electronically with no moving parts! The COLLECTOR by Zestron is the only ionizer on the market that cleans the air powerfully enough to accomplish this test.

SUPERPOWER OUTPUT

The COLLECTOR by Zestron is the only bipolar collecting ionizer with superpower output. The thoroughness and speed of air cleaning increases with more ion output, and Zestron ionizers give you the highest output (without detectable ozone). Check the comparison chart below. Don't buy any ionizer not stating output using the industry standard of ions/cc/ sec. at one meter.

IONIZER	ADVERTISED OUTPUT (1 m.) ions/cc/sec.	COLLECTOR
The COLLECTOR By Zestron	1,200,000	YES
JSA Bubble	???	YES
Aspen	???	YES
Orbit	???	YES
AirCarell	236,000	YES
Ion Fountain	540,000	NO
Ion Cloud	350,000	NO
Ionosphere	350,000	NO
Modulian	75,000	NO
Ion Breeze	???	NO

FREE ION DETECTOR

A FREE remote ion detector comes with each ZESTRON to verify and compare output. When you place the detector next to a ZESTRON and a competitive unit, you will see greatly reduced or no output from the competitive unit!

SILICON VALLEY TECHNOLOGY

The COLLECTOR, incorporating years of high reliability design experience, is built in the heart of Silicon Valley, USA, using quality parts operating under low stress. It is designed to give you space age performance and years of trouble free service. The COLLECTOR operates anywhere in your home or office on regular current for pennies a month. It has no moving parts and nothing to wear out or replace.

THOUSANDS OF SATISFIED USERS

Don't you, your family and friends, deserve the healthy clean fresh air that Zestron ionizers have brought to thousands of satisfied users? Users write:

"I simply cannot believe how much better I feel physically" Dr. E.K., DDS - MA

"I smoke heavily and it has cleared the air as advertised" G.P. - WA

"I haven't taken the top off my nasel decongestant spray since using your product. I was previously a chronic user." G.S. - SD.

When you use your COLLECTOR, you'll quickly feel the difference it makes and smell the freshness in your air. You'll actually see the elimination of smoke and dust in your air!

SATISFACTION GUARANTEED

Order a COLLECTOR now and try it in your home or office risk free for 30 days. You will probably want more units, but if for any reason you are not satisfied, return the unit for a prompt and courteous full refund including your return postage. The COLLECTOR has a full one-year warranty on both parts and labor, excluding abuse.

ADDITIONAL DEALERSHIPS AVAILABLE

Reorders are pouring in, customers write:

"We are enjoying the results of the first one and are ordering two more" Dr. J.B., M.D.-CA

"Very pleased with the first unit . . . send two more" Dr. D.M., D.C. - CA

"I'm a distributor for three other ion companies, and have to say I am extremely, extremely impressed." T.N. - CA.

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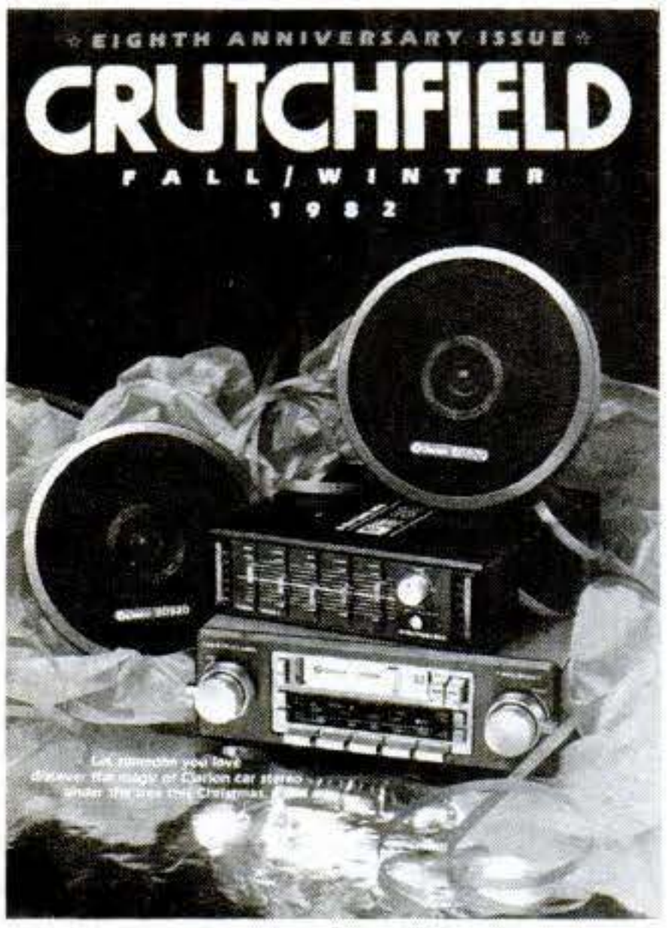

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Losses in the video signal are corrected by video add-ons such as the Video Ventures Showtime enhancer (top) and distribution amplifier (right). Other boxes, such as Select-A-View from The Cable Works (left), control where the signals go. And stereo synthesizers, such as this one from Vidicraft (bottom), enhance the audio.

Boost the video signal, and you also boost electrical noise and color information. That means you see "snow" on the screen. To compensate, enhancers have two controls: one to increase detail and another to lower noise. But since both controls boost or attenuate the same signal, adjusting them becomes a fine line between an enhanced and a snowy picture.

Although enhancers can increase the quality of the picture you see (Bo Derek was an 11 on my projection TV), they're most useful for recording on a VCR. A VCR can severely limit the high frequencies of a signal (which is why the playback you normally see is not as clear as the original). With an enhancer, the signal can be boosted before recording. The playback signal is then much closer to the original.

A basic enhancer box, such as the Vidicraft Detailer I ($149), has only enhancement controls. But add to the price, and you get more gadgetry. The company's $295 Detailer II, for example, also contains an input switch that allows up to three audio/video sources to be selected for processing. The PGR Dub-Master 1 has a manual-auto fade control. Use it when dubbing one tape to another and you get professional fade-outs between scenes (although the one I tried didn't fade the picture out entirely).

Video Ventures' Showtime model includes a "stabilizer" system. "Copyguarded" tapes (prerecorded tapes that can't be copied by another VCR) will no longer cause picture rolling. (Some TV sets can't lock onto the copyguarded signal, and the picture rolls vertically. Using it also means copyguarded tapes can be copied—but the legality of reproducing copyguarded tapes is now being determined by the courts.)

Units from Video Ventures and Vidicraft also contain signal-processing circuits to correct or boost color when dubbing or editing home video movies. Kermit the Frog is supposed to be green but Aunt Harriet isn't. No problem: Play your video movies through the signal processor and rerecord them on another VCR. She'll look just fine—and Kermit will be greener than ever.

While many of the enhancers allow a signal to be fed to multiple TV's or recorders, some may not. For those, yet one more box is needed to complete your system: a distribution amplifier. One, such as the Video Ventures VV-70P, will amplify and distribute the video signal to five other accessories. A meter lets you monitor the exact video signal—a control allows you to adjust it. The idea is to give each component the proper video level and to prevent one device from interfering with another.

Now that the picture's perfect, what about the sound? For that, you can try one of the stereo synthesizers from Rhoades and Vidicraft. Attach the monaural TV audio line to the input of the synthesizer; the ouput is two stereo channels for your hi-fi.

Although I had to strain to hear any true stereo from these boxes, I liked the more elaborate unit from Vidicraft ($249). It also contains an adjustable noise-filter system that

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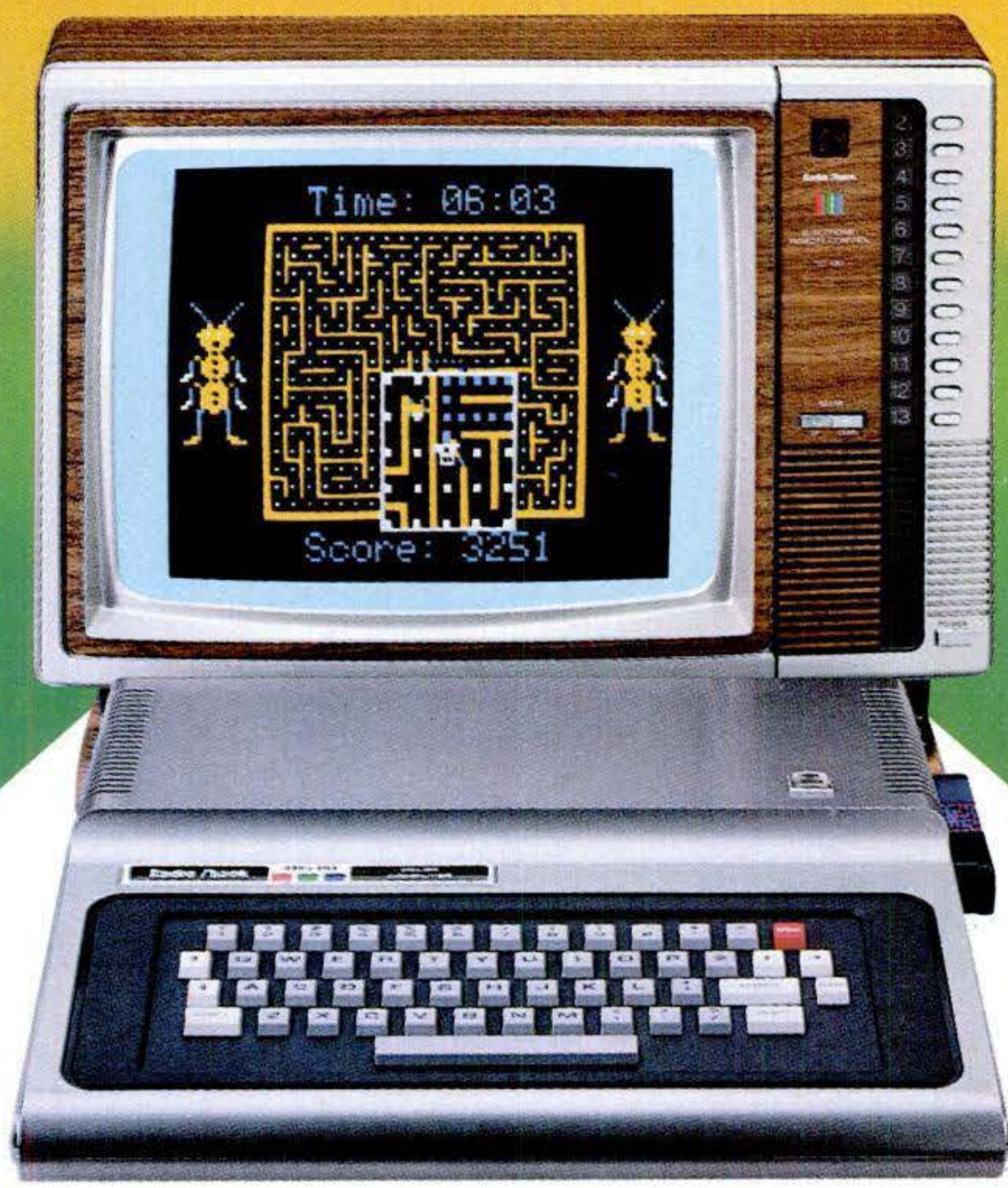

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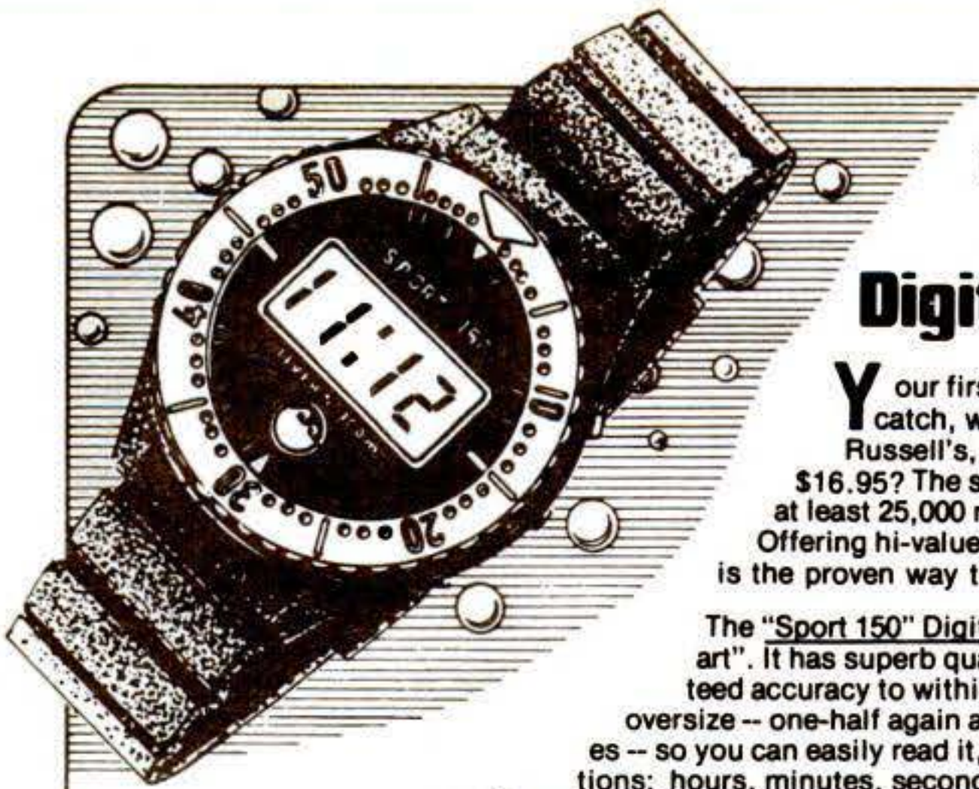

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works very well—the normal hiss and buzz I've come to expect from TV audio is removed.

Finally, if you're in a hurry, there's the Video Ventures Voice Tracker—it allows you to listen to the audio track at about twice its normal speed without any change in pitch (the Donald Duck syndrome). To use it, however, you must make internal electronic modifications to your VCR.

Simple, but clever

If your shelves—or your wallet—aren't up to all these boxes at the moment, there are two add-ons you may want to check out: The Combiner from The Cable Works and Video Ventures' Video Camera Enhancer.

The Combiner ($60) accepts two RF inputs—the antenna and a VCR or pay-cable box. One output jack connects it to other TV's around your home. Its trick: All the TV's connected to the box get normal network reception on all channels except Channel 3. Turn a TV to that channel, and you can watch a tape from your VCR or a movie from cable. You've created your own private channel.

And for moviemakers, there's the Video Camera Enhancer. It simply attaches in-line between your video camera and portable recorder. Every scene you shoot is automatically enhanced before it goes on tape. PS

MANUFACTURERS' ADDRESSES

Amco, 9181 Gazette Ave., Chatsworth CA 91311; **The Cable Works,** 4228 Santa Ana St., South Gate CA 90280; **PGR Laboratories,** 266 Jericho Tpke., Floral Park NY 11001; **Radio Shack** (local outlets); **Rhoades,** Highway 99 East, Columbia TN 38401; **Video Ventures,** 2715 5th St., Tillamook OR 97141; **Vidicraft,** 0704 S.W. Bancroft St., Portland OR 97201; **Zenith Radio Corp.,** 1900 N. Austin Ave., Chicago IL 60639.

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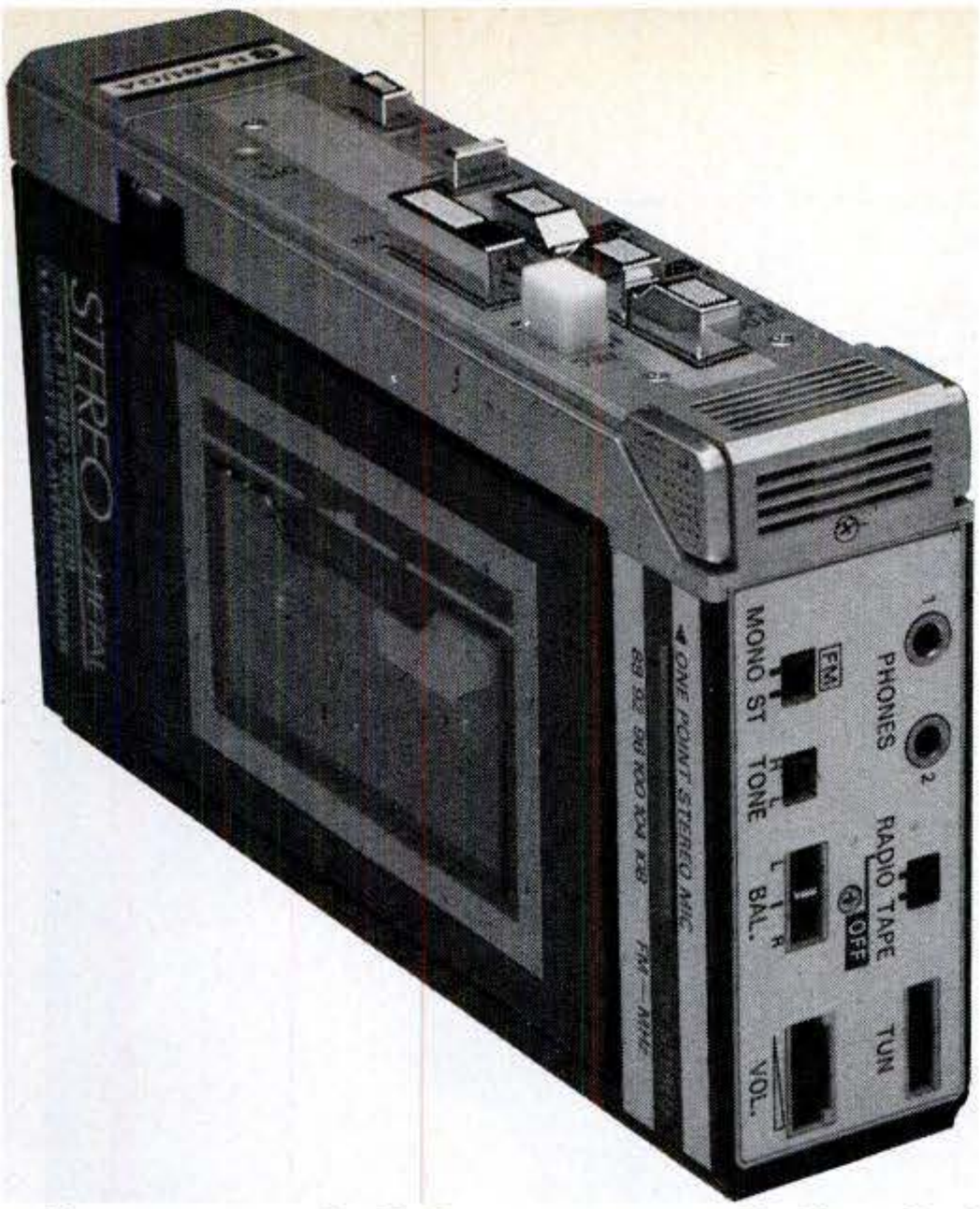
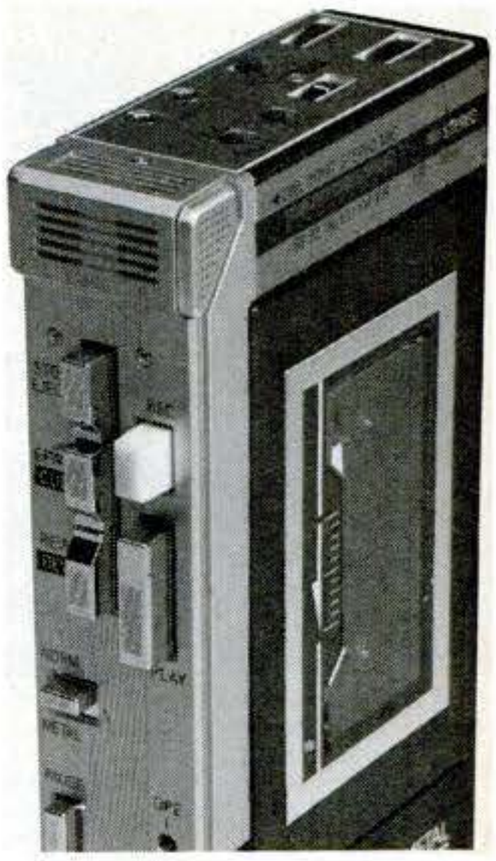


It records!



Kasuga What?

It records! In stereo! And, it plays both cassettes and FM stereo.

You're at a concert. While you stand in line waiting to get in, you're listening to a 'preview' of the artist on cassette.

As the concert starts, just pop in a blank cassette. And, you'll have your own personal recording in full stereo of the actual concert you attended.

It'll be complete with all the little personal comments and happenings that make each concert special. Note: It may be illegal to record some live events.

But, if you're not into recording live events, consider your next airplane trip. While the rest of the passengers sit bored in thier seats wating for the 'exciting' movie to start, your mind will be soaring a million miles away as you listen to your favorite music.

If you get a million dollar idea or if you just want to dictate some letters, pop in a blank cassette and you'll be dictating in real style.

Of course you'll be dictating in stereo, (compatible with all monaural transcription machines). You'll have one button record, pause, and cue and review.

You'll even have a tape counter to keep track of the exact position of your thoughts, or during musical play, the location of specific songs on the tape.

REALLY FOR MUSIC

And, speaking of music, that's what this stereo recorder/player is all about.

Most better personal stereos have a high/low tone switch and some even have a normal/metal switch. Both are tone controls. This machine has both, for multiple level tone control.

Of course you have 2 headphone jacks, which is really neat because you're going to get **2 pairs of headphones** with this personal stereo. So, read on.

But first you ought to know what a Kasuga is. It's a company in Japan, where this recorder is made. You've probably never heard of Kasuga, but then you're probably not Japanese.

We at DAK have sold over 40,000 personal stereos and we look at literally dozens of different machines.

Even if Kasuga isn't a brand name you are likely to know, it's a substantial company in Japan. In the unlikely event that service should be required, there is a local service by mail facility.

WHAT SOUND

The sound is easily equal to a several thousand dollar home stereo system. Yet, the Kasuga Recorder is only 6½" by 3¾" by 1½". It comes in a hard protective leatherette case that attaches on your belt or with an adjustable strap.

So, whether you are into long walks, sitting in airplanes or washing your car, you can now hear better sound than when you are sitting in front of your home stereo.

ENGINEERED FOR STRESS

Most fine stereo equipment is designed to be lovingly placed on a shelf and never moved. Obviously this isn't a practical way to listen when you're walking your dog, skiing or commuting to work.

The Kasuga recorder incorporates a special tape movement system with a unique stabilizing mechanism that tends to keep your music stable even when you're not. (Caution: Absolutely no personal stereo is perfectly stable, but the Kasuga is excellent).

It is operated by 4 standard AA batteries, (not included), has an LED operation indicator, and it shuts itself 100% off at the end of a cassette. There is a single volume control and separate balance control just like on a home stereo.

SUPERB FM STEREO

The Kasuga has a built-in FM stereo tuner that really locks in on your FM stations. It uses the headphone cord as its antenna so that when you're on the move, your FM stereo stations won't be. Stereo /mono switching is automatic, or you can take control with a switch.

You can record direct from the FM by simply putting in a blank cassette and pushing record. The level control is automatic. And, if you want to record from other outside sources like other tape decks or tuners, there's an 'aux' input as well.

TWO PAIR OF STEREOPHONES

The most important single element to the great sound produced by any personal stereo is the Samarium Cobalt headphones. Well, Kasuga makes absolutely superb cassette decks, but frankly we didn't like their headphones.

At our expense, so it's free to you, we are adding our own fabulous pair of Samarium Cobalt stereophones. With a frequency response of 20hz to 20,000hz and sound levels up to 100db, you'll experience a mind blowing sound extravaganza with these headphones and the Kasuga that is second to none.

So, you'll get one fabulous set of headphones and one we think is only so so.

TRY THE KASUGA RISK FREE

Take your Kasuga wherever you go. Listen to absolutely incredible sound from cassettes or FM. Then make your own great recordings from the built-in stereo mikes, the FM tuner or any outside 'aux' source.

If you aren't 100% satisfied for any reason, simply return it and the free second set of phones in their original boxes within 30 days for a courteous refund.

To order your Kasuga Recorder/Player complete with 2 sets of stereophones risk free with your credit card, call the DAK toll free hotline or send your check for only **$89** plus $3.50 for postage and handling Order No. 9455.

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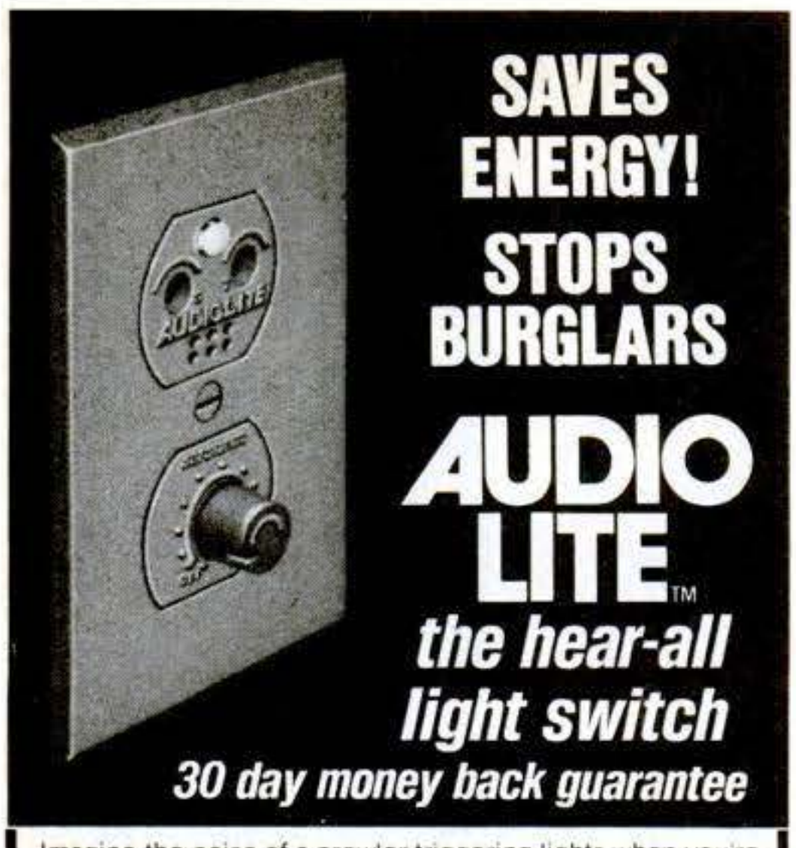

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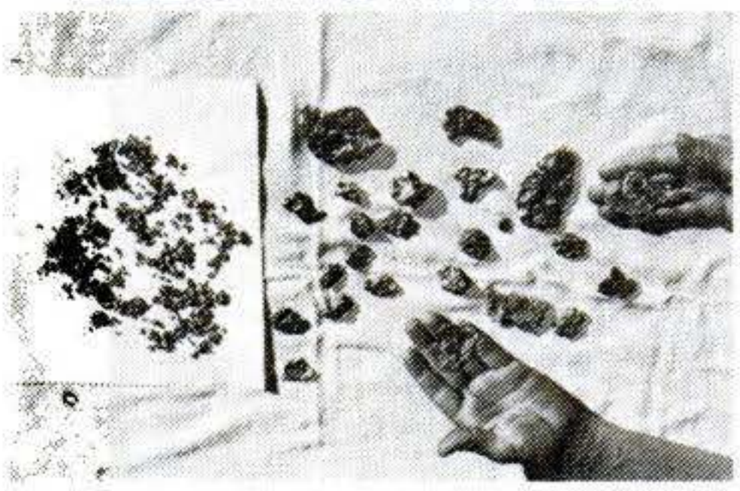

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BITS & BYTES

By WILLIAM J. HAWKINS

Big things in small packages

On the outside, that desk-top computer you see above looks fairly conventional: large video display, full keyboard, floppy disc, built-in hard disc, and even a built-in printer. But wait. Study the insides, and you'll find that calling this *just* a desk-top computer is a bit like calling the shuttle *just* an airplane. You're looking at a $100 million "super minicomputer."

The HP 9000 series is the first in a family of new Hewlett-Packard 32-bit "main-frame" computers. Each of these work stations is capable of doing the work that previously required a room-size system. All of its power comes from just five integrated circuits. They're made using a new process developed by HP called NMOS-III. It's a way of squeezing transistors—in this case a phenomenal 450,000 of them—into a thumbnail-size container. (The bottom of the inset photo shows the five chips. They mount on the boards you see and are installed in a lunch-pail-size box for use.)

Just as important, NMOS-III chips also can be mass-produced. While the prototype may cost $100 million, the actual stations will start at $29,000. That's incredibly low, considering the HP 9000 will replace a large main-frame computer costing up to four times as much.

The unit takes up about as much room as a newspaper—yet it contains a color graphics display, keyboard, printer, 10-megabyte Winchester-disc drive, 256K flexible-disc drive, and 2.5 megabytes of error-correcting and (are you ready?) "self-healing" internal memory. (If a bad memory cell is detected by the system, a new one is automatically used in its place.) It uses HP's BASIC operating system or Bell Laboratories' UNIX and is HP or Ethernet compatible for communications with other computers.

At present, the HP 9000 is designed primarily for engineers and scientists. They're the ones who need this machine's million-instructions-per-second speed or its ability to handle up to 500 million pieces of data. But if this technology has created a main-frame computer in a desk-top package that costs one-quarter the price, what will happen when it filters down to personal or home computers? Maybe that's already starting:

Exceptional price

The Spectravideo personal computer you see at the top of the following column is $300. That's typical of a starting price tag, but look what you get with it: It has 32K of RAM, a 32K ROM that contains Microsoft's BASIC interpreter, a word-processing package (the keyboard joy stick controls the cursor), CP/M 2.2, and CP/M Plus for using simpler commands. And, according to a company spokesman, the unit also accepts Coleco game cartridges.

Continued

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The Timex Sinclair 1000 allows you to use your own TV as a display monitor, and your audio cassette recorder for storing programs. For under $100* you get everything else you need, including our step-by-step learning guide that'll have you running programs within hours. And writing them within weeks.

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Bits & bytes

[*Continued*]

Of course, the disc drives (5¼ inch, $525 each) are optional, and you'll need the interface box ($175, in rear of photo)

to make them work. Spectravideo, 39 W. 37 St., New York, N.Y. 10018.

Working together

A variety of schemes is now available for "networking" small business computers. That means a number of desk-top units—in an office, perhaps—can communicate with each other. You could create a letter at your desk, for instance, and send it to someone else in the office for checking. Or everyone in the office could use a common mailing list stored on one floppy disc.

It's a great idea, but the problem now—especially for small, desk-top machines—is a lack of standards. Each network system requires its own special hardware and software, and no two designs are alike. So if you intend to combine computers, you're gambling that the system you choose will be in existence years from now.

If you're using an IBM personal computer, however, you could hedge that bet with the 3Com EtherLink system (see photo). It uses the Ethernet system, designed and backed by Xerox (which should be around for a while).

For $950, you get a disc of software and a printed circuit board that merely plugs into an internal slot (connector) on the IBM. The output of the board is a 50-ohm coaxial-cable connector that links your computer with any similarly equipped IBM PC (or any other Ethernet-compatible gear).

The software is easy to use: Once it's entered into the computer, you use the standard IBM disc-operating system commands as before. There are a few exceptions. File transfers, for example, are done automatically between other computers

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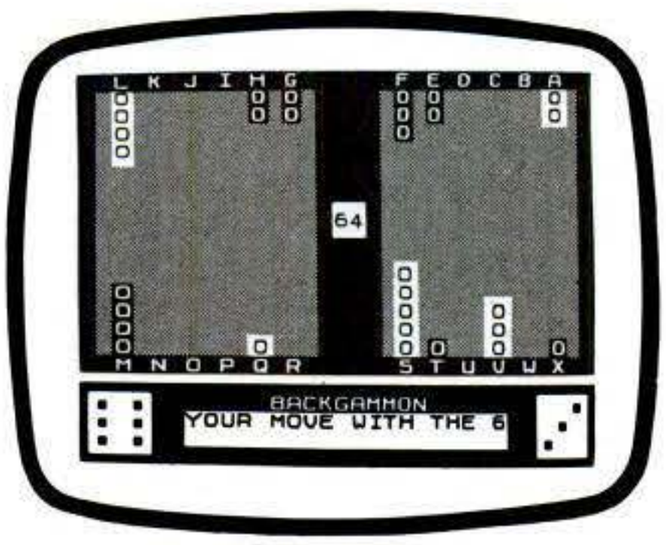
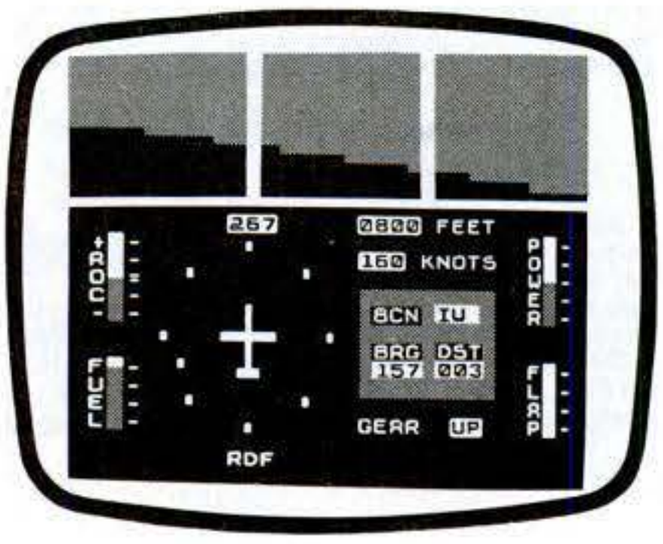
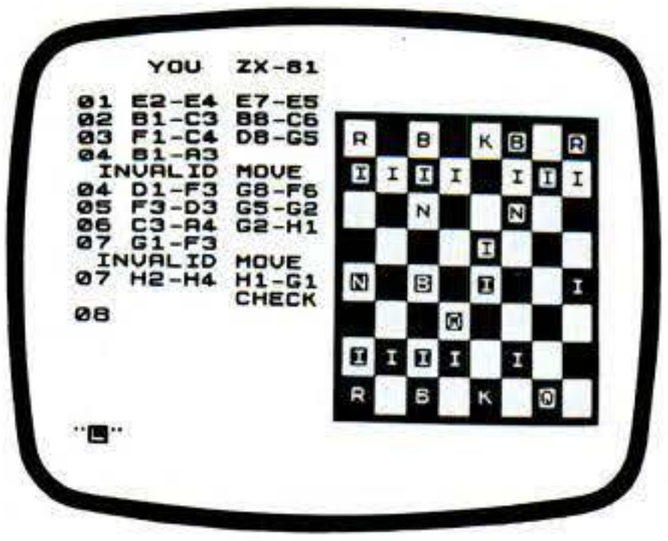
Games that challenge you at a price that won't.



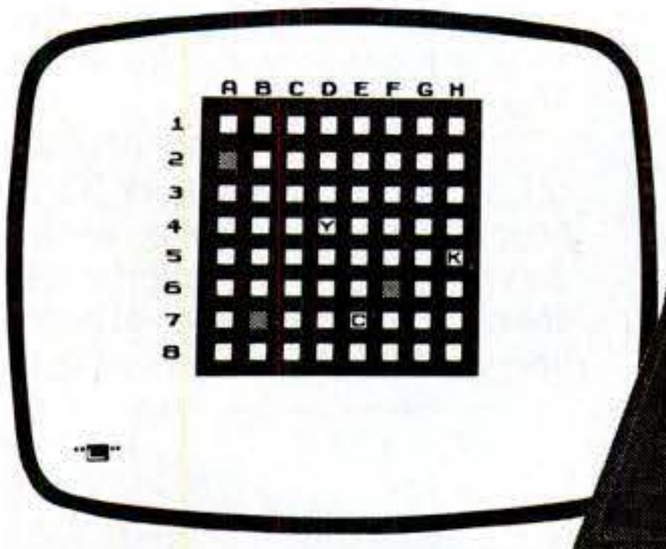
BACKGAMMON



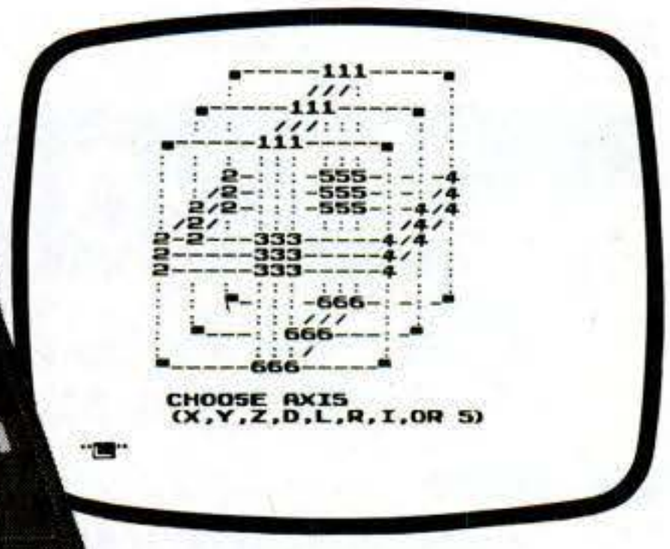
FLIGHT SIMULATOR



CHESS



MIXED GAME BAG



CUBE GAME

Look to Sinclair for the only $99.95 computer and the first Serious Games Package. A special limited time offer. Call toll free today.

What could be more challenging than creating your own games on a personal computer? Or being intellectually challenged by serious games where you match wits with a computer or another opponent in a fierce trial of skills?

The Timex/Sinclair 1000* is a fully programmable computer with a powerful BASIC language and complete instruction manual, all for only $99.95. The moment you sit down with the TS1000 you can learn how to program your own games. Maybe you want to create a stock market game, a word game, a mathematical game. The challenges are endless.

For this one low price, the TS1000 comes with everything you need for connecting the computer to your color or black-and-white TV.

Of course, you might also want pre-programmed software cassettes for your $99.95 computer. You'll have a wide choice with our free software catalog which comes with the TS1000. And the software cassettes play in any cassette recorder.

The 16K Memory Module. More power to you.

Let's say you want to go one step further. The 16K Memory Module allows you and your family to be challenged by even more sophisticated games. Not mindless arcade games, but serious, intellectually stimulating games which are both fun and educational.

The Memory Module costs only $49.95 and plugs onto the back of the TS1000 for 8 times more memory capacity. A whole new world of software is available to those with the 16K Memory Module.

The Serious Games Package. A $75 value for only $50.

For those who want a lot of serious 16K games, Sinclair announces a special software offering with a $25 savings! Now, for the first time, you can receive all five games shown above at the reduced price of only $50.

Chess: You can play with another opponent or you can match wits with the computer.

Flight Simulator: Maneuver and land a light aircraft with full cockpit controls, instrumentation and navigational aids. You have to allow for wind velocity and direction, rate of descent and mountainous terrain.

Cube Game: Every bit as mind-baffling as Rubik's Cube.

Backgammon: Everyone's favorite. Again, you can play against another opponent or against the computer. Complete with a doubling cube.

Mixed Game Bag: A series of memory and concentration tests including Memory Magic where you have to repeat sequences on the screen.

There's never been a better value on a serious games package. And to think it all starts on a $99.95 computer!

Why order today?

In addition to saving $25 on software, there are other reasons to buy your TS1000 today. Computers costing hundreds and even thousands of dollars rarely offer you games this serious or challenging.

Another reason to order today is convenience, by toll-free phone. No crowds, no waiting lines, no parking worries. It's never been easier to get started in the world of computers. Or more worthwhile.

How to order today!

Just call our toll-free number and use your MasterCard or VISA. Or send the coupon with a check or money order. Then try out the Timex/Sinclair 1000 for 10 days at no risk. If you're not entirely satisfied, we will refund your money. It's as easy as that. (Sorry, no refunds on software.)

Call toll-free: 800-543-3000. Ask for operator 509. In Ohio call: 800-582-1364. Ask for operator 509. In Canada call 513-729-4300, operator 509. Have your MasterCard or VISA ready when calling. Phones open 24 hours a day, 7 days a week. These numbers are for *orders only.*

If you simply want information, please don't call, write Sinclair Research, Ltd., 2 Sinclair Plaza, Nashua, NH 03061.

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☐ Check or Money Order enclosed

	Price	Qty.	Amount*
TS1000	$99.95		
16K Memory Module	$49.95		
16K Cassettes	$15.00 each		
Special Serious Games Package (5 games valued at $75.00)	$50.00		
Shipping/Handling	$ 4.95		$ 4.95
*U.S. Dollars		Total:	

Cassettes for 16K Memory Module: $15.00 each.
Check the boxes of all the cassettes you want.

☐ Flight Simulator #6
☐ Chess #7
☐ Backgammon #8
☐ Cube Game #9
☐ Mixed Game Bag #26
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*Sinclair technology is the heart of both the ZX81 and the Timex/Sinclair 1000 computer.

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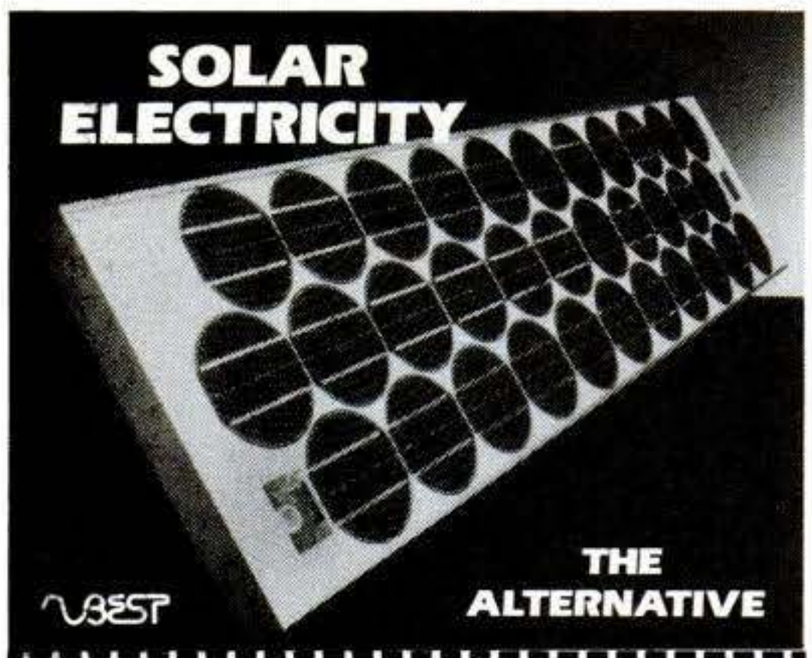

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6.	Anti Matter Splatter (Nuclear Disaster)	$24.95	$19.95
7.	Bug Blast (Creepy)	$19.95	$16.95
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10.	Krazy Kong	$16.95	$14.95

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Bits & bytes

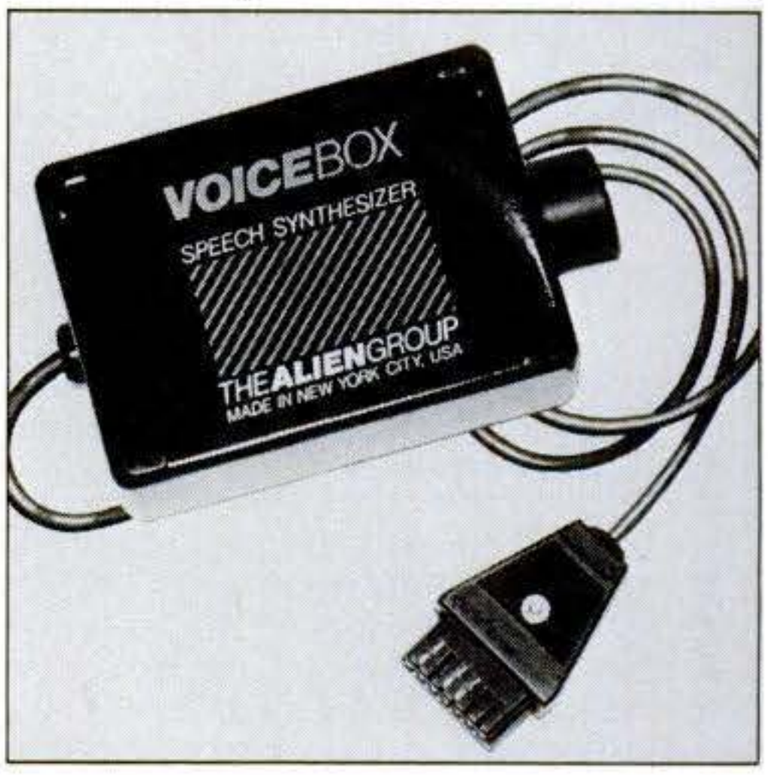
[*Continued*]

on the network. Computers can also share peripherals, such as a printer, and with an $11,500 option called EtherShare, up to 20 machines can share a 10-megabyte hard-disc system. For more information, write to 3Com Corp., 1390 Shorebird Way, Mountain View, Calif. 94043.

Talk to me

The box is small—it fits in your hand. The connector simply plugs into an unused connector on your Atari 800 or 400 personal computer. A disc is inserted, and the program it contains is run. Result: Type in a sentence, and the computer speaks the words using speech synthesis. That's not all.

The Voicebox, from The Alien Group (27 W. 23 St., New York, N.Y. 10010), is programmed to speak in a variety of ways. You can use phonetic spellings to create your own special words (proper names, foreign words, or sound effects,



for example). Or you can just type in standard words; the software that comes with the Voicebox will look up each word in its electronic dictionary to determine the correct pronunciation.

Besides creating speech, the software also has a bit of fun with graphics. In one mode, you see a drawing of a face on the video screen. As the computer talks, the lips move in sync with the words.

The speech quality from this tiny box is excellent. And a front-mounted control allows you to change the speed and pitch—from a slow, deep drawl to something akin to Donald Duck.

Two models are available: The AL-5001 ($169) is for the Atari and comes on cassette or disc. The AL-3001, for the Apple, has circuitry and software on a board that plugs into the computer. (Custom dictionaries can still be added on disc.) It costs more, $215, but this model is also able to sing songs—in any key you wish.

The last word

Finally, a last-minute entry from Atari: The company has introduced the Model 1200XL personal computer for under $1,000. It comes with 64K of memory and is compatible with peripherals and programs for the earlier 400 and 800 personal computers. PS

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By STEVE MERCALDO

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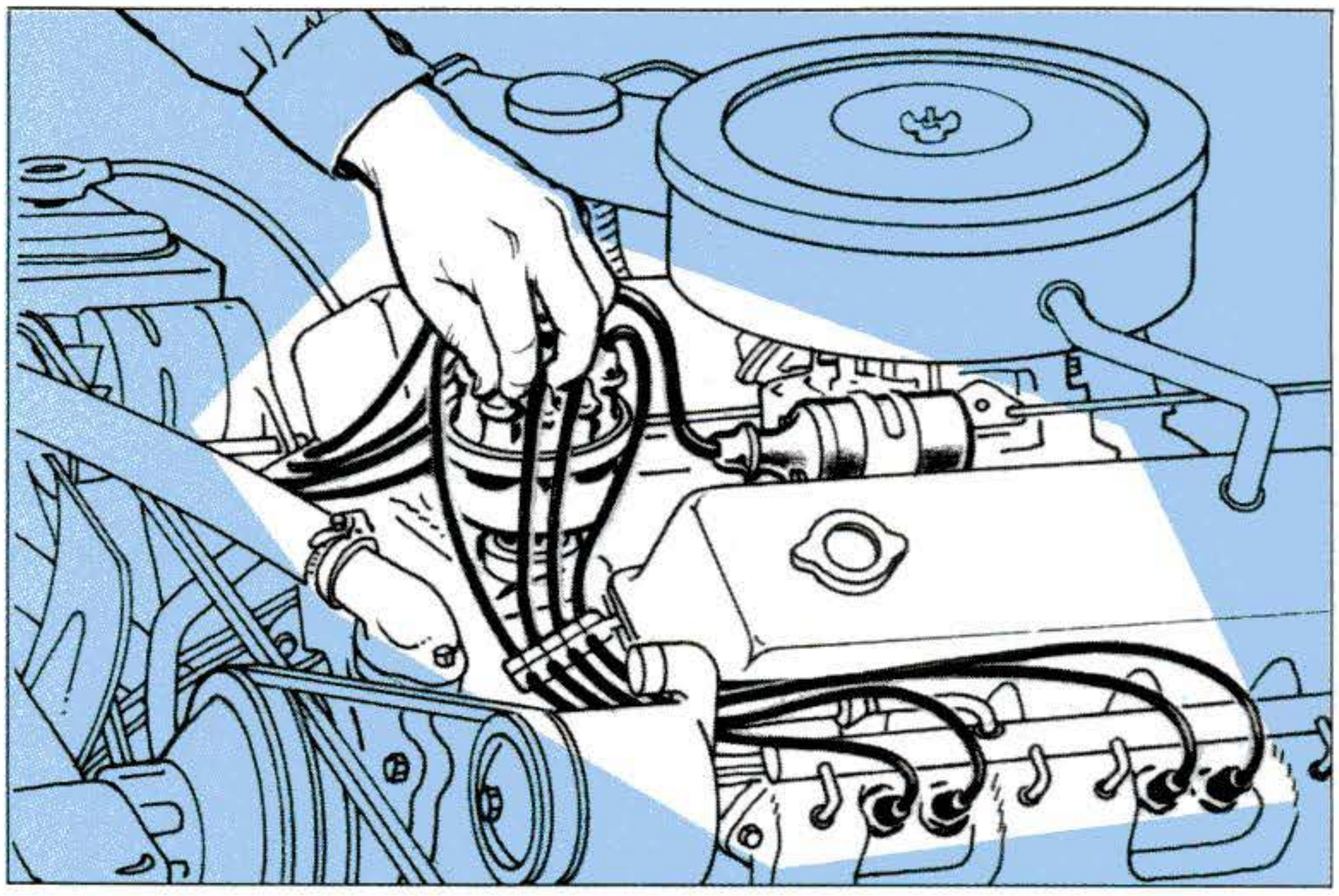
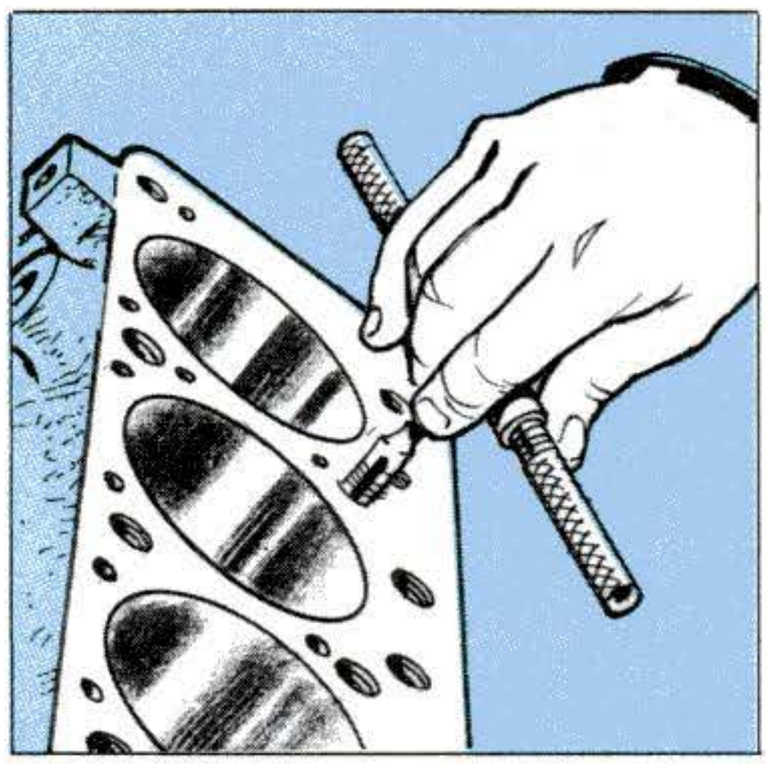


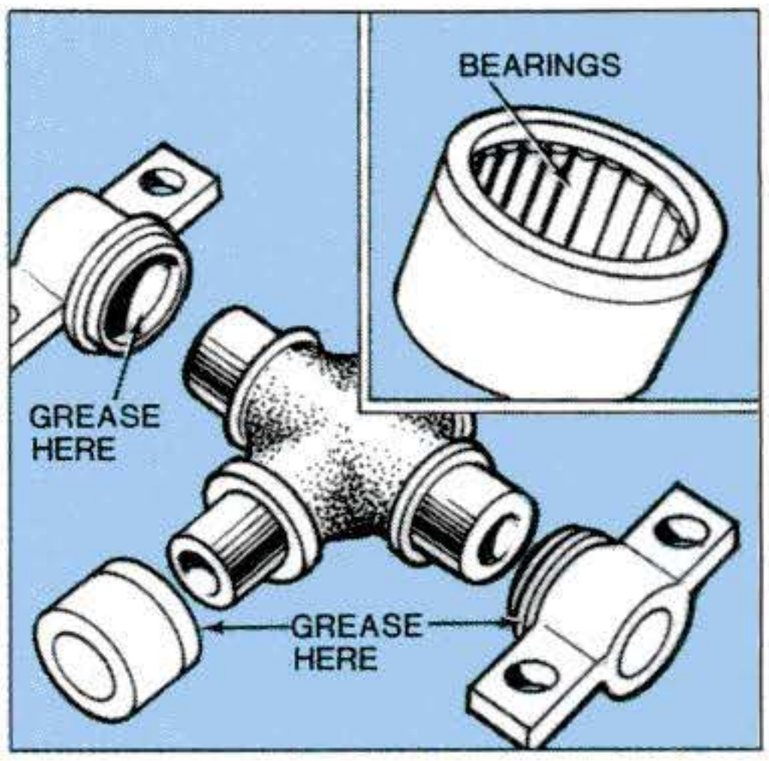
Radio interference? Check for a bad wire

A faulty high-voltage ignition-system wire can cause an annoying crackling sound in your car's audio system. You can recognize it since it varies with engine speed. To find a bad wire, follow these steps. Begin by inspecting the spark-plug wires and coil wire for obvious insulation damage or corroded terminals. Then, using an ohmmeter, test each wire for an open circuit. Check that all wires are fully seated on the distributor cap, coil, and spark plugs by pushing them down firmly onto each terminal. Finally, use the shop manual's wiring diagrams to check that all wires are properly routed from the distributor to the correct plugs.



Blown head gaskets

Dirty engine-block bolt holes may cause repeated cylinder-head-gasket failures. Dirt and sealant can accumulate in hole threads and cause head bolts to tighten prematurely. This can result in a correct torque-wrench reading but a loose cylinder head. To ensure proper tightness, clean bolt-hole threads with the correct-size lubricated tap. Also, clean and lubricate bolts before reassembly.



A universal problem

Cross-and-yoke-type universal joints are used in most drive shafts. Friction is reduced between the yoke and cross by needle bearings. These tiny rollers are tough to keep in place during assembly after inspection or replacement. Here's a slick way to keep them from rolling away: Apply a thin coat of grease to the bushing's inner wall and install the rollers. The sticky film will hold them in place.

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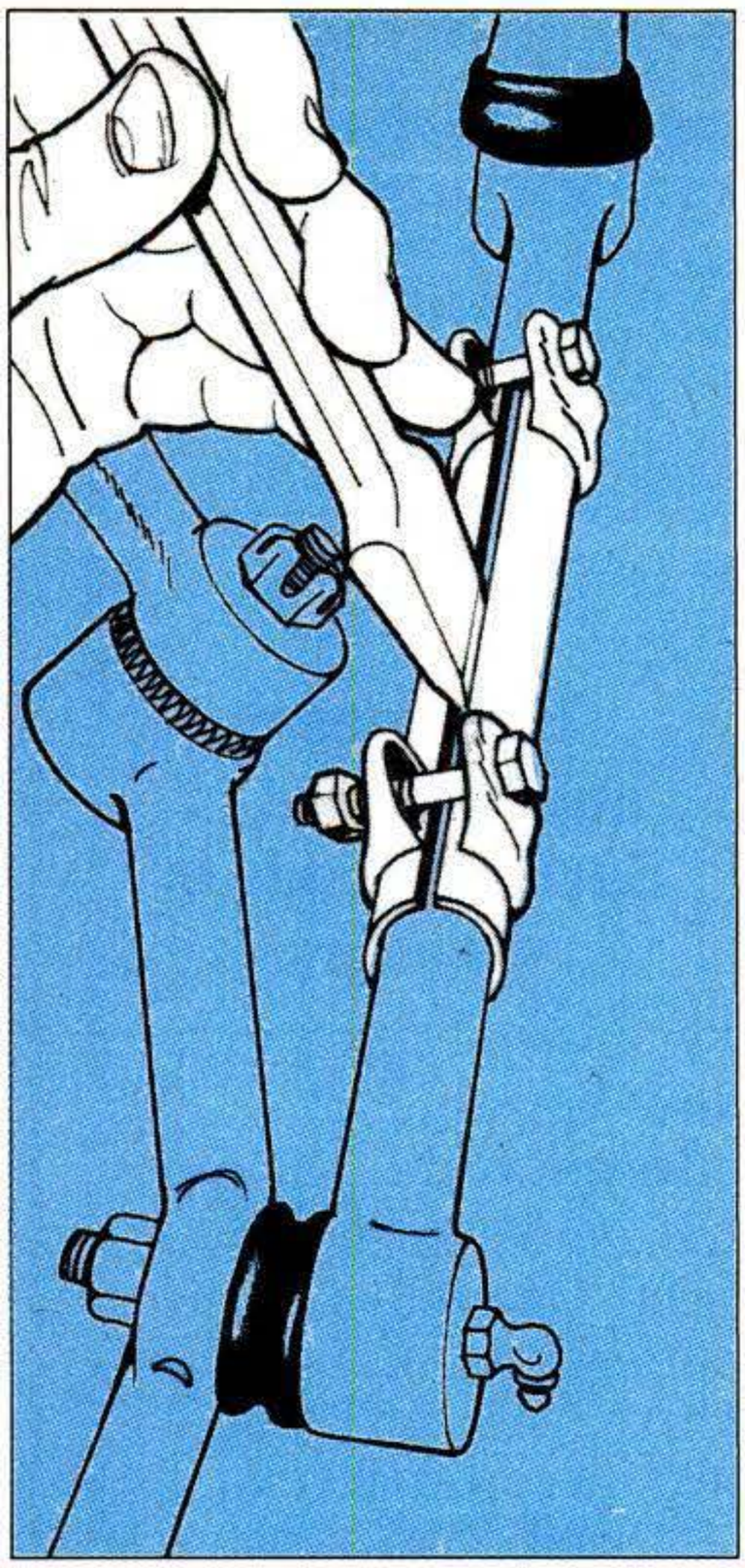
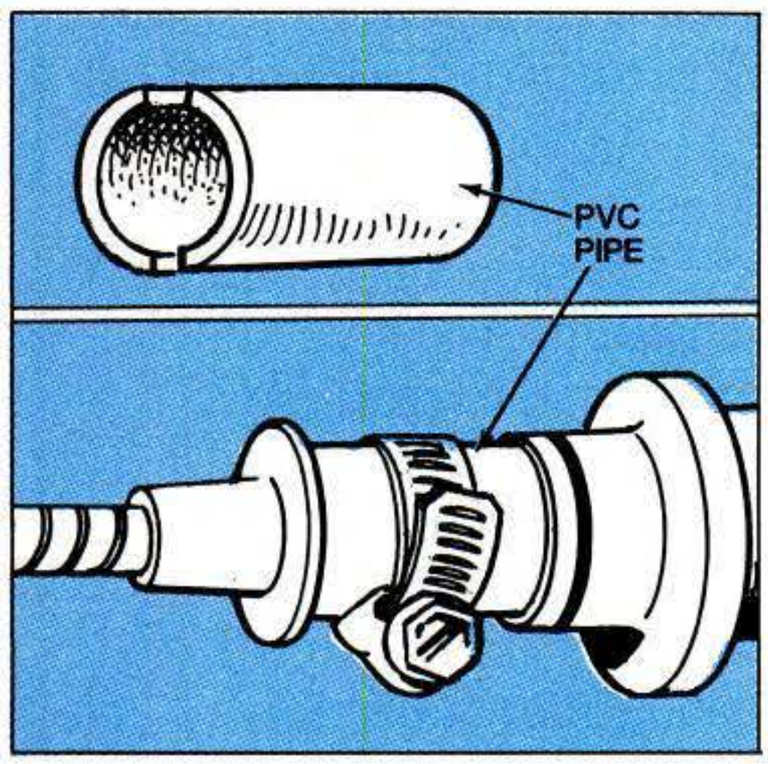


Stubborn tie-rod sleeves

A tie-rod sleeve that is rusted in place can be serious if you need to adjust front-end toe-in or replace a worn tie-rod end. If penetrating oil fails to free the sleeve, try this. First, loosen both sleeve clamp bolts. Then hammer a chisel into the slot in the sleeve. The chisel's wedge should spread and loosen the tight sleeve.



Quick clutch fix

The Chevy Chevette uses a cable-type clutch-release linkage. It's inexpensive and works well. However, the adjustment sleeve's grooves can break. A quick fix is to clamp Vise Grips onto the adjustment sleeve to take up the slack. For a more permanent repair, cut a piece of ¾-in. PVC pipe to the proper adjustment size. Then slice it lengthwise, and clamp both halves over the sleeve as shown.

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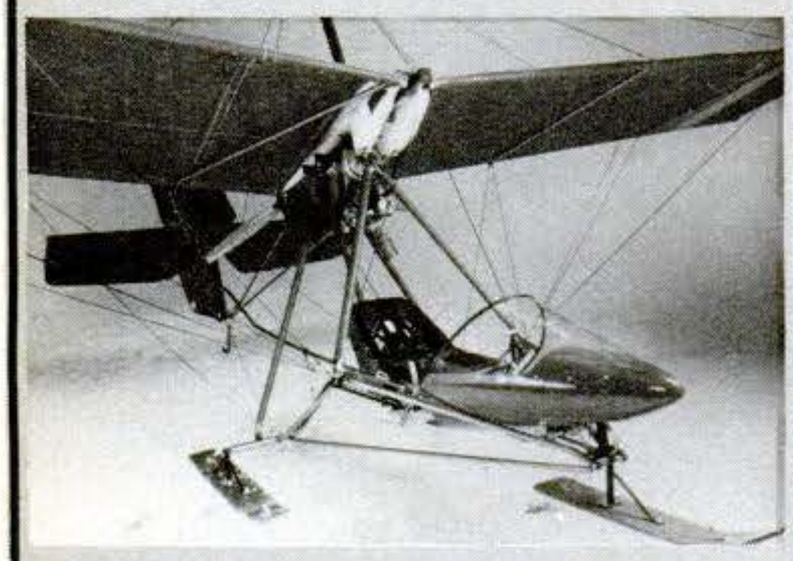

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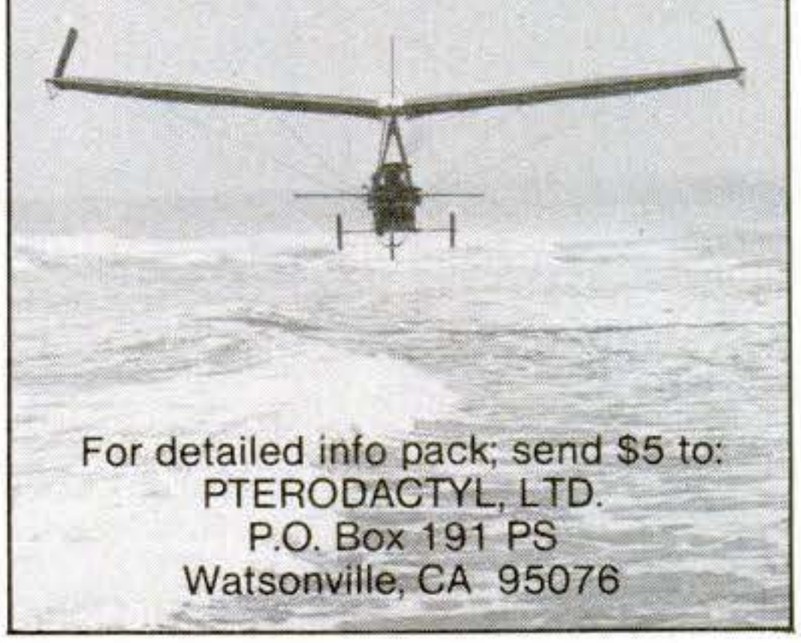

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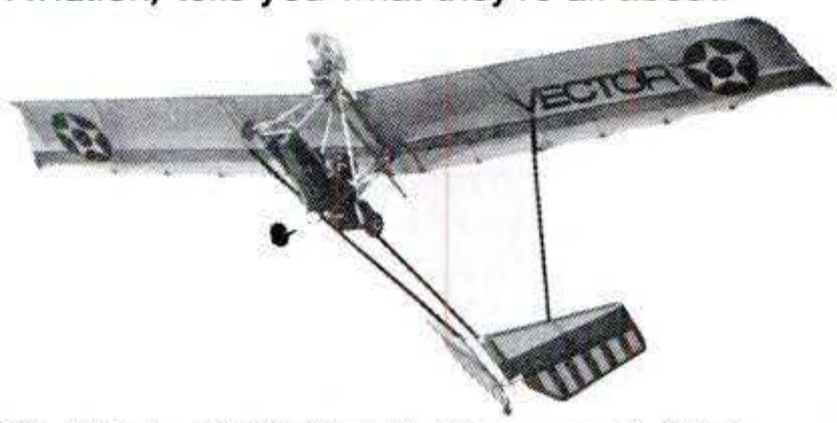

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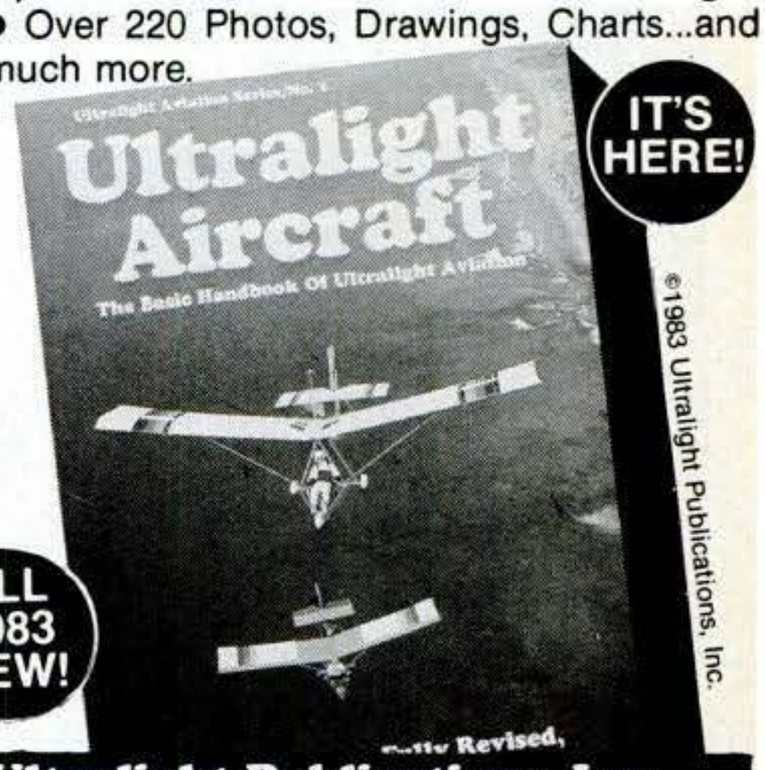

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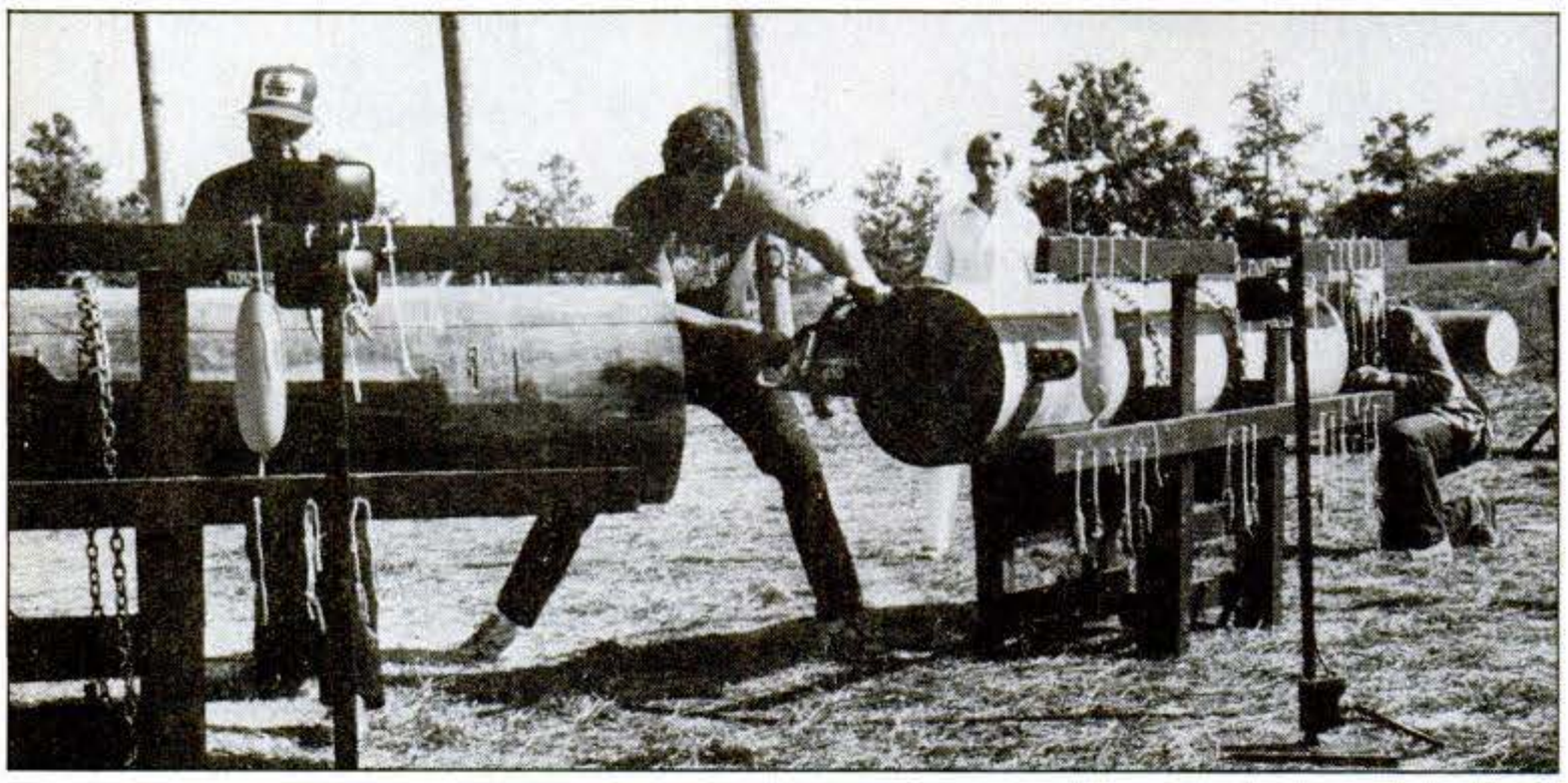
SHOP TALK

By AL LEES



How to ruin a chain

As a sidelight to this month's double feature on chain sharpening, I can report that I witnessed some bizarre professional examples of the art at Homelite's annual Tournament of Kings last fall near Charlotte, N.C. This is the multi-event meet that brings the world's top loggers together to find who is fastest and most skillful with a chain saw.

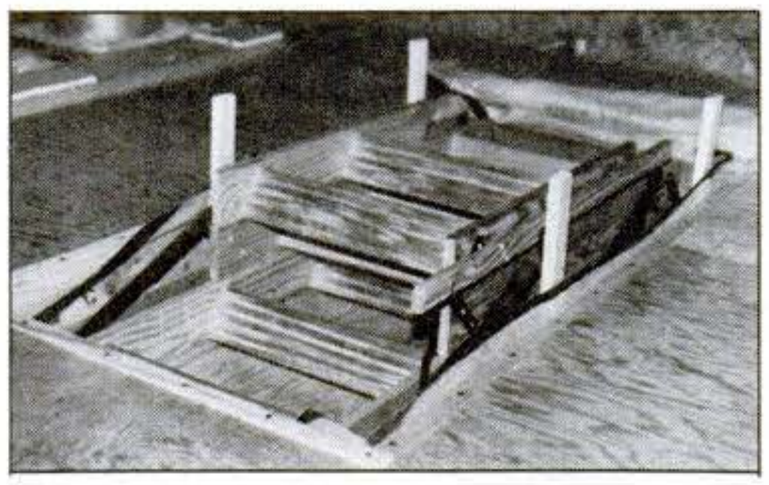
My photo at the top shows the precision-boring event, where competitors must plunge the blade through a log precisely enough to pop balloons racked on the other side. For boring, no modification is made to standard pro saws, but for the tournament's climactic event—speed cutting—entrants are permitted to file their chains any way they wish. In the second photo, Jack Stewart, one of this year's finalists, inspects his competition chain before this final event. Jack's a machinist as well as a logger, so he doesn't do any filing by hand. He literally rebuilds his chain, taking it apart completely. His main purpose is to lighten it by half, and to change the teeth angles for improved chip flow. The process may take up to 40 hours per chain. Jack hastens to point out that all this wrecks the chain for anything but speed events—and could prove dangerous in normal use.

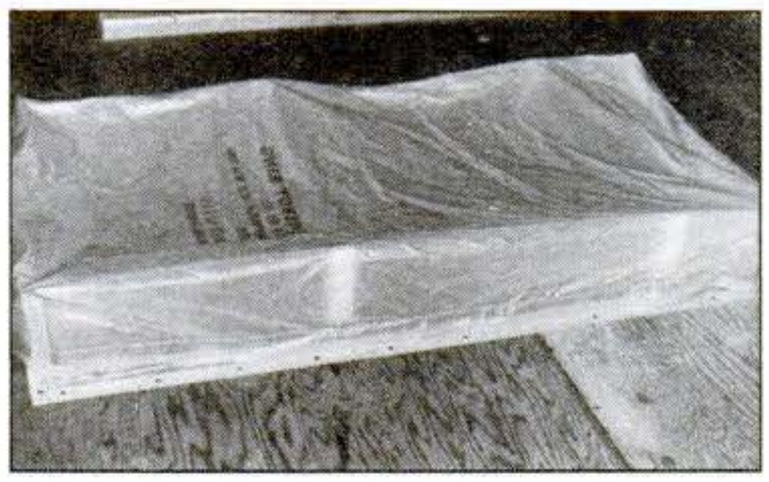
Who won the tournament? Not Jack, for all his efforts, but a two-time previous winner from Oregon, Roy Booth. Roy had lost out to his son two years back, and both Booths missed the crown in '81. Now dad's brought it back home. "Roy is a master at chain filing," says Jack.

Want still more on chain saws? Two makers offer new booklets you can send for: "Operator's Safety Manual" is free from Husqvarna, 224 Thorndale Ave., Bensenville, Ill. 60106. "Sharp Advice for Chain Saw Owners" concentrates on the chain; it's available from Stihl dealers—or by sending 50¢ to Marketing Services, Stihl Inc., 536 Viking Dr., Virginia Beach, Va. 23452.

Plugging another heat leak

Is your home one of the 24 million in the U.S. with pull-down-folding-stair access to the attic? In cold climates, this gap in your ceiling insulation can cost you dearly in lost heat: Cold air drops through the cracks when the stair is in its stored position (first photo at bottom). Now an easy-to-install zipper cover can cut this loss by creating a dead-air space above the opening. The kit includes a canopy of vinyl laminated to a nylon weave with a heavy-duty zipper to let you through, four support posts, and 15 feet of seal strips. It's $35.50 from Energy King, Box 1037, Wappingers Falls, N.Y. 12590.





Catch 'em young

My favorite letter this past month was from a reader who says he'll remain devoted to PS for life because it helped save his two sons from becoming "useless jocks or arcade-game cowboys. I gave my boys a subscription in their early teens," he goes on, "and it worked: One son read it to keep up with computer technology, the other for workshop techniques. Now one's a programmer, the other runs a cabinet shop—and they're interesting people to talk to."

This reader and I are not alone in thinking you can aid the complex maturing process if you stimulate kids to creative endeavors during their formative years. I was struck with the coincidence of two books on that subject hitting my desk just this week: *Carpentry for Children,* by Lester Walker, and *Woodworking with Kids,* by Richard Starr. Though remarkably similar in approach and intent, the books don't duplicate projects. Both feature several hundred delightful demonstration photos of kids using woodworking tools, and either book would be a fine introduction to the joy of making things. Both authors are sharing their long experience of teaching woodworking to children—and their enthusiasms are infectious.

Starr teaches in New Hampshire and takes a broader view of what constitutes a shop project for kids: His early chapters show nursery-school children making very crude toys and boxes, while later chapters describe sophisticated creations by older kids. Starr also includes a thorough "Tools and Techniques" section, but he deliberately withholds detailed plans or measured drawings, since he feels a child should come up with his or her own design—a moot point. The 216-page, big-format hard-bound is $18.95 from Taunton Press, 52 Church Hill Rd., Newtown, Conn. 06470.

Walker is a bit less loose in his teaching techniques. He directed a crew of four upstate New York kids (from 10-year-old Molly to 13-year-old Ben) through a series of projects of increasing complexity, dictated by the kids' own interests but shrewdly designed by Walker, who gives dimensioned layout instructions for each. Walker (an award-winning architect who has designed major projects for PS) *starts* with tool techniques, then proceeds to building simple sawhorses, a workbench, and a toolbox. His earnest crew works up from one-day projects (birdhouse, block set) to one-week projects (a usable raft and coaster car). The 208-page hard-bound is $14.95 from Overlook Press, c/o Viking, 625 Madison Ave., New York, N.Y. 10022. Take your pick, dad. PS

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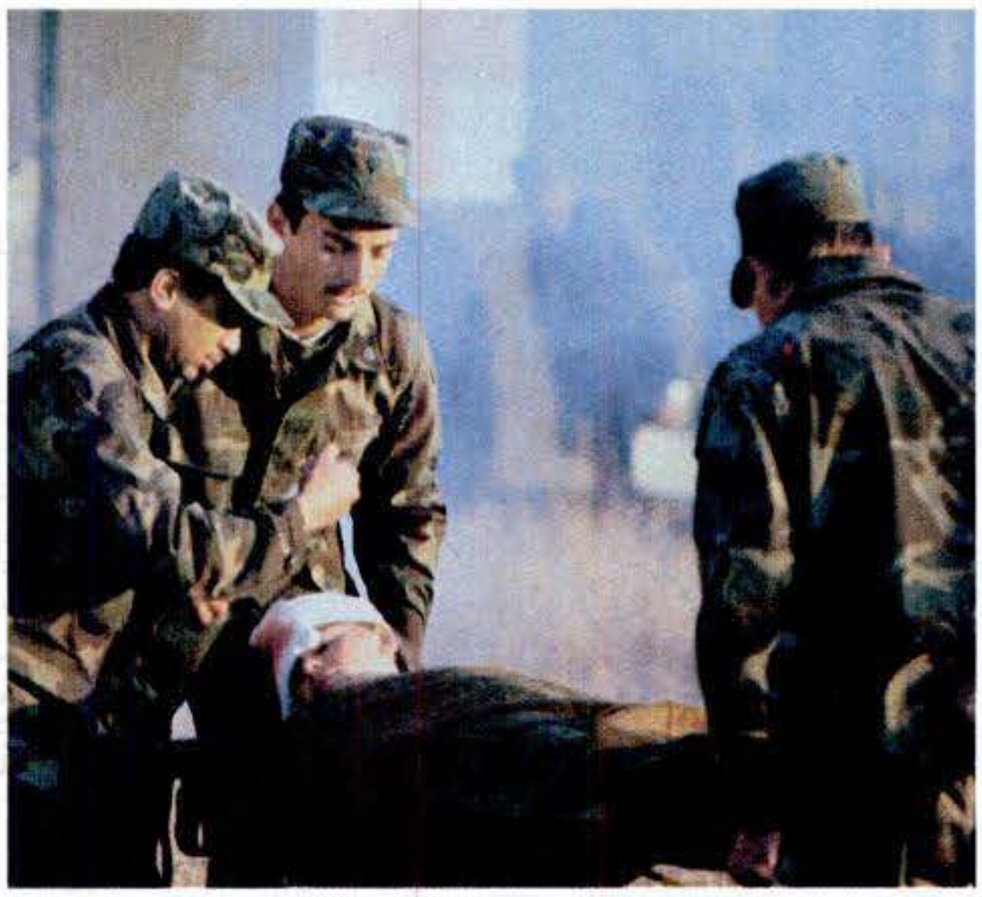

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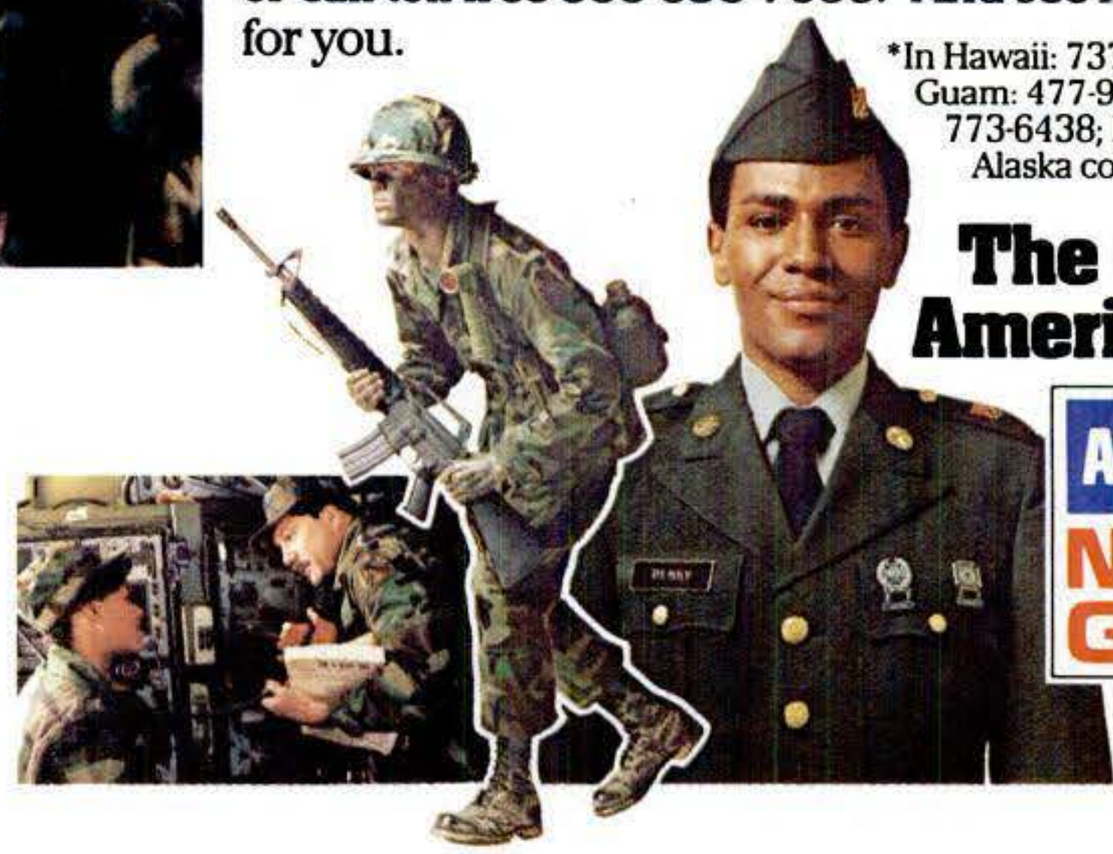

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Anti-counterfeit system

spots fakes with high-intensity beam

"In effect," says Ron Katz, chairman of Light Signatures, "we're giving manufacturers a birth certificate for every product."

That "birth certificate" is part of a system that Katz hopes will put merchandise counterfeiters out of business—along with the retailers who buy and sell rip-off records, tapes, jeans, and sneakers. And it can be just as effective in collaring crooks who fake pacemakers, brake linings, or *any* product.

Light Signatures claims its system distinguishes the fake from the authentic efficiently and inexpensively. And record companies Arista and Chrysalis, as well as apparel makers Levi Strauss and Nike, are already putting it to work.

Unlike previous anti-counterfeiting systems, this new system does not attempt to foil fakers by attaching identical hard-to-duplicate items—such as logos printed on thin film, or bubble-plastic stickers—to each product. Instead, Light Signatures' system makes use of the individuality inherent in all organic material—particularly in paper. When magnified, the fiber content of paper shows a distinct pattern of crisscrosses and whorls, much like a fingerprint.

Before a product is packaged, Light Signatures passes a high-intensity beam of light through a small section of the label, box, or other such material that the manufacturer customarily uses. This beam forms a shadow (the "fingerprint") that is read and given a unique digital coding by a computer. Since different parts of the material produce different readings, the coding can also include coordinates that will later direct the computer back to the same spot on the label for verification. The computer assigns 3,000 to 4,000 of these coded IDs an hour to the labels. The labels are then sent to the factory where they become part of the products' packaging.

How do the labels stop counterfeiters? Products without the digital stamp will be easily recognizable as fakes to merchants, field reps, and educated consumers. So if counterfeiters want their products to look like the real thing, they will be forced to copy the tag. But then the code number won't match the composition of the paper counterfeit.

Record companies currently offer premiums, such as fan-club information or discount coupons, to encourage consumers to return the labels to Light Signatures for verification. And Levi Strauss is sending out field reps to purchase the goods, clip the labels, and return them. Says Katz, "You don't need all of them; you just need a statistical sample of where they're sold."

At Light Signatures, the same computer that assigned the digital stamp compares the returned labels with the shadow pattern. If the digital reading doesn't match, the computer spits out the label.

Since the label returner has given his name and address as part of the premium offer, it's a simple matter for the FBI to contact him and learn the identity of the dishonest merchant.

What if the labels were stolen in the mail en route to the manufacturing plant? Says Katz: "When those labels came back, we'd say 'That guy's not just dealing in counterfeit goods, he's dealing in *stolen* goods.'"—*Danny King*

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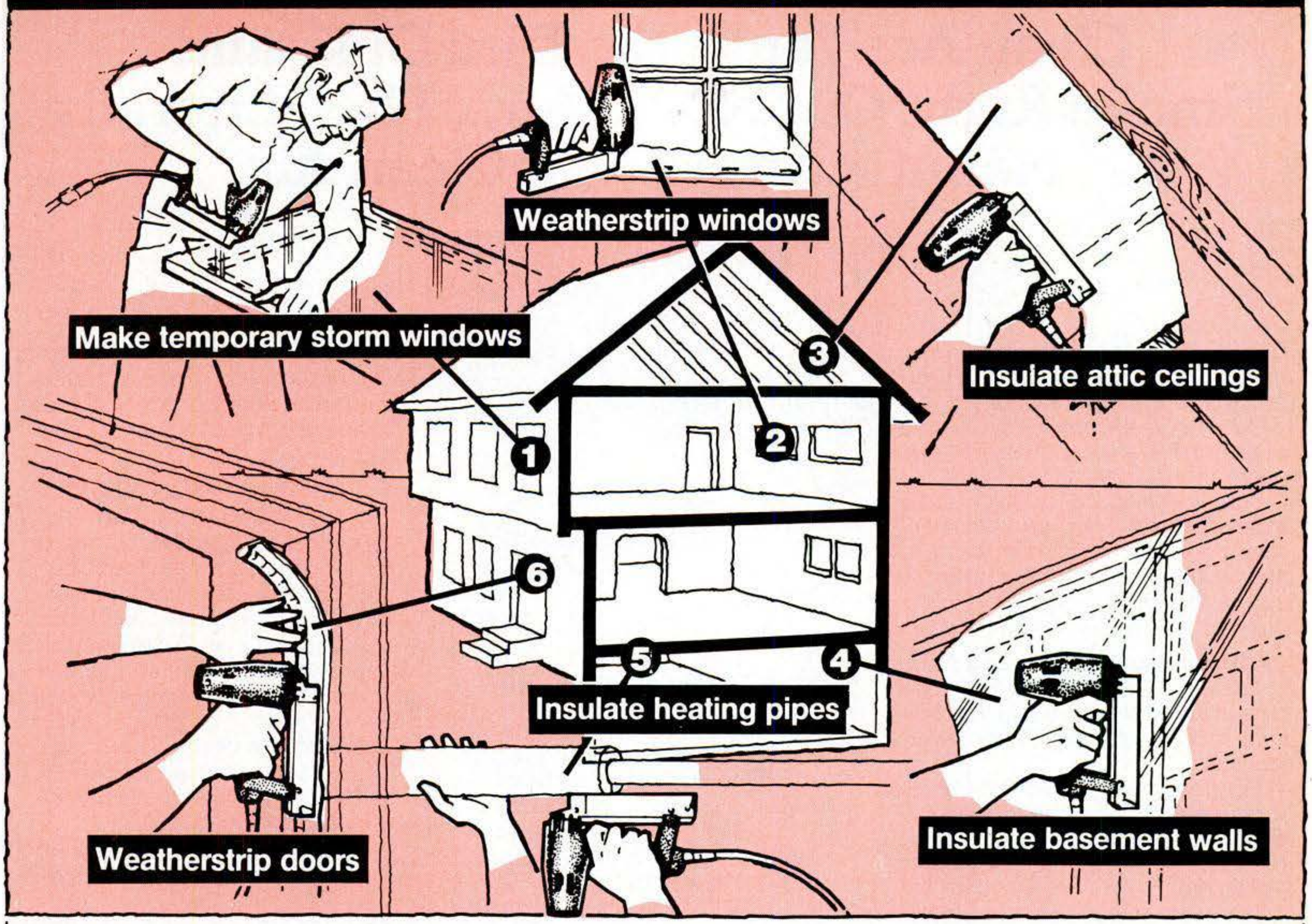

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The second, high wavelength kills not only germs but also the tiny "mites" that can be so irritating (and socially unacceptable). You might notice an immediate **decrease** in the number of runny noses and colds. It's no accident.

Will you Actually Feel Better?

We think you'll feel better because the air will be so pleasant and refreshing to breathe. Many, many people report the disappearance of their tiredness and general irritation when the air is properly ionized.

An opinion is one thing; a fact is another. The ability of the CLEAN ACE to kill germs and airborne pests is a **fact**. The feeling of well-being you get from fresh ozone is a **fact**. The oxidizing effect ozone has on bad-smell molecules is a **fact**.

Of course the CLEAN ACE is absolutely safe. The special ultraviolet quartz-glass tube doesn't transmit the high-range rays that can redden the skin. The unit plugs into any wall outlet, and because it "creates" fresh air you don't have to open a window.

Unbelievable POWER

The home-size Model 8200 CLEAN ACE is 11" wide, 7½" high, 5" deep. It weighs only a couple of pounds. It makes no noise.

The home-size CLEAN ACE Model 8200 cleans the air in an average room in about 10 minutes.

Can you believe it will clean the air in an average room in about 10 minutes? Can you believe it works with every window shut and the heater or air conditioner on? Can you believe you'll be able to see the ugly black particles from your room the CLEAN ACE has trapped in its super-efficient filter?

You'd better believe it.

You don't assemble anything. We'll include a descriptive booklet, but there's nothing to learn: just press the "On" button and let it run.

END EMBARRASSMENT FOREVER!

If someone is bedridden, somehow odors start to accumulate. Never again!

If even two or three people smoke at a party, the air is blue with smoke. Never again!

If you have a meeting in your office or conference room, after a while the air is heavy, even foul. Never again!

If you're cooking, the aroma of fish, shrimp, lamb, and many vegetables seems to hang there forever, gradually changing from "aroma" to "smell." Never again!

Now—
A CLEAN ACE for Your Car!

The Model 1000 mounts under the dashboard or sits on the seat. Plug it into the cigarette lighter, and smog, pollution, grime, and stale air never will touch you.

What a difference clean air will make when you're driving around town or when you're stuck bumper-to-bumper in rush hour traffic, where normally you'd be inhaling the carbon monoxide from the exhaust of the car in front of you!

If someone is a smoker, instead of driving around with smarting, burning eyes, turn on your CLEAN ACE Model 1000 and forget that cigarette or cigar is lit.

COMFORT IS AS NEAR AS A PHONE CALL

We've seen old-fashioned air cleaners which lack the space-age technology of the CLEAN ACE, selling for up to $245. New Horizons is a direct-factory source, and you'll be able to own this **high-powered** air cleaner for far less than you'd expect to pay in a store—if they had it.

Here's how to order:

The powerful home-size CLEAN ACE Model 8200 is yours for just **$139.95**, plus $4.50 for shipping.

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Send check, money order, or credit card information (VISA or MasterCard) and we'll ship your CLEAN ACE Air Cleaner immediately.

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After you have your CLEAN ACE, plug it in and use it for up to a full month. If for any reason you don't want to keep it, send it back for a full refund, no questions asked.

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Model 1000 — **$119.95**
add $4.50 per total order for shipping

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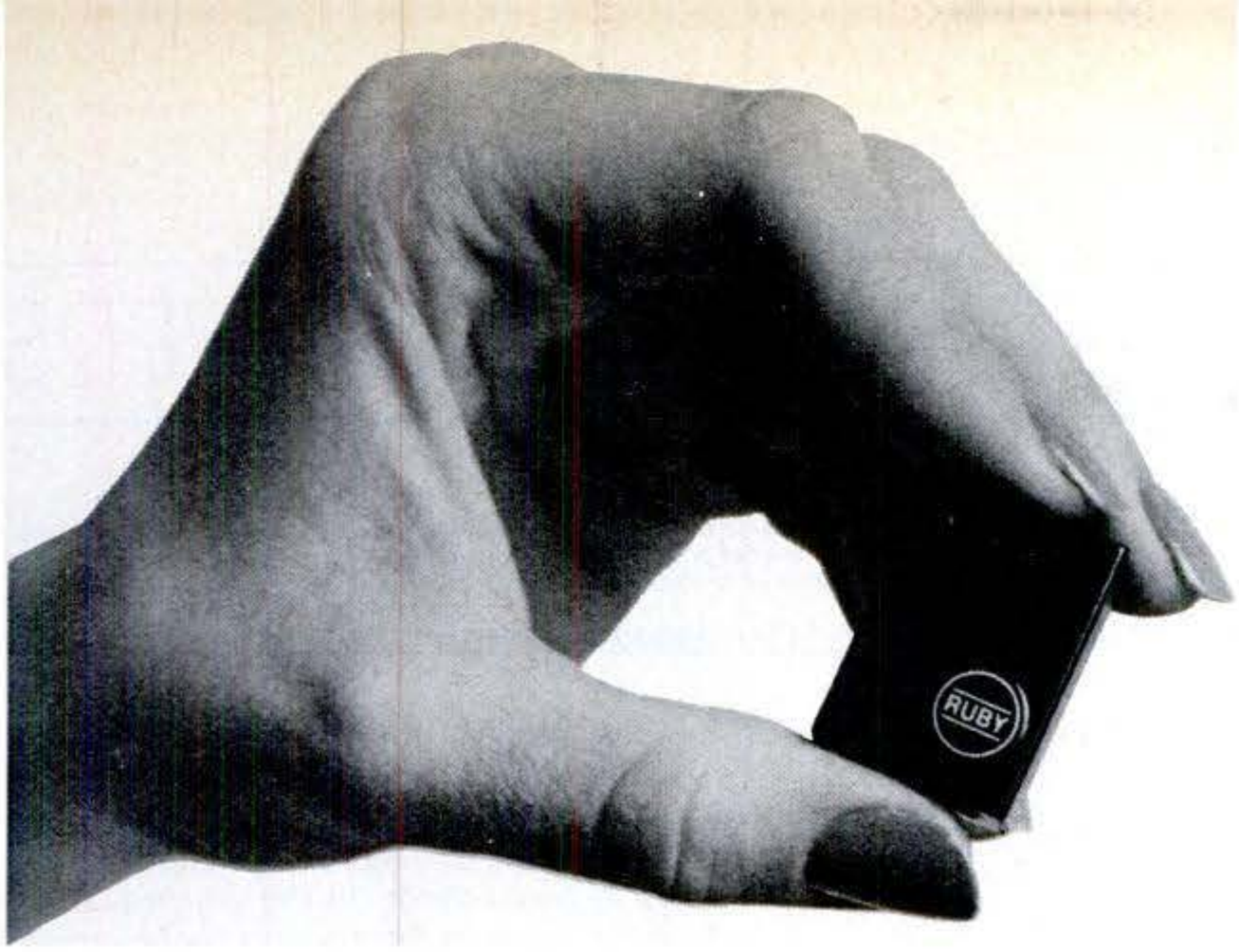


Bionic "Ears"

Tiny, powerful electronic sensors give you superhearing — through walls, up to 1/2 mile away.

The **Dyna-Mike Transmitter**

It's smaller than a quarter. But DYNA-MIKE will transmit every sound in the room to an FM radio tuned to the proper unused frequency, up to half a mile away.

If you're at a neighbor's home a block from your own, you can hear your baby's cry, or you can tell the instant your spouse comes home. If two of you are driving tandem in two cars, one or both of you can communicate with the other even if other cars drive between you.

DYNA-MIKE has as many uses as your imagination can think of. For a business conference, let the tiny microphone sit unobtrusively on the table or concealed on a shelf, and you'll be able to record every word. For businesses, put an FM receiver in a warehouse or remote office and "broadcast" instructions or orders to be filled.

Public speakers never had a better friend than the DYNA-MIKE. No wires or setup — just turn on one or more radios and your speech will come through with perfect fidelity. Put one on the front porch. If you hear a suspicious sound, turn on the radio and you'll hear the doorbell or even a muttered conversation.

Choose Your Model

New Horizons is introducing three models of the DYNA-MIKE supersensitive broadcast microphone. Model AR-7 is the world's smallest microphone. it's a miracle of electronic miniature power, with a range of 750 feet and a battery life of 90 hours. Introductory price is $129.95 (two for $119.95 each).

Model 9-DX is a long-range microphone, broadcasting an unbelievable half-mile distance. This miniaturized wonder is $149.95 (two for only $139.95 each). Normal battery life is 25 hours, or you can have the special Power-Pak, which operates 200 hours, for $19.95.

The AR-7 and 9-DX are sensitive. They'll pick up sounds from 40 feet away. But for super-sensitivity, nothing beats the A-5.

The A-5 will pick up a whisper from more than 60 feet away and broadcast it to a receiver 750 feet distant. The A-5 comes with a special 200-hour long-life battery and is introductory-priced at $99.95 (two for only $89.95 each).

The **Telephone Voice Changer**

It's right out of James Bond! Push a button and the VOICE CHANGER gives your voice completely different characteristics. The person on the other end of the phone won't know it's you.

The VOICE CHANGER is more than an "electronic handkerchief" — it doesn't cause your voice to sound filtered. It literally changes tone and timber.

Choose from two separate, distinct Changer Channels. If you're alone in a business office, it'll sound like an employee answering. If you live alone, you can get rid of pesky calls by pushing Channel 1 or Channel 2 and saying, "Sorry, that person isn't in."

How It Works

The VOICE CHANGER is powered by two ordinary penlight batteries. One set of lead-in wires connects to your telephone base; the other clips to the wires leading to the handset.

Pushing the button labeled "Ordinary" puts your normal voice through the line. Pushing "Channel 1" changes timber and texture. Pushing "Channel 2" creates different characteristics from Channel 1. Thus you have three voice options — your own, plus two changed voices.

MAKE NO MISTAKE! THE VOICE CHANGER DOESN'T MUFFLE YOUR VOICE OR MAKE IT UNINTELLIGIBLE. It literally changes the quality of sound — space-age electronics at work.

Use the VOICE CHANGER to reach that doctor, lawyer, or business executive whose secretary knows your voice and who always is "out" when you call. Use it to screen your own incoming calls. Use it for just plain fun. Any time you like, during a conversation, push the "Ordinary" button and your regular voice returns to the wire.

The VOICE CHANGER is yours for $99.95 — two for $89.95 each (plus $2.50 shipping per total order). When you consider the many uses of this brilliant electronic instrument, it's a real bargain. Of course it has the standard New Horizons guarantee.

The **Super Ear**

You'll hear it all.

Effortlessly, you can hear not just a baby's cries, but quiet breathing — through a concrete wall a foot thick. Put the earphone in your ear and place the SUPER-EAR on the wall. That's all there is to it.

SUPER-EAR hears everything — and, even more astouding, hears it clearly. It's as though the wall weren't there. If you're coming home late at night and think intruders are in your residence, let SUPER-EAR find out for you. Want to know if the meeting is over in the room with the closed door? SUPER-EAR will tell you in a second.

SUPER-EAR is undetectable from the other side of the wall. The quality of sound has amazing fidelity — good enough to record, and SUPER-EAR has its own built-in recorder jack.

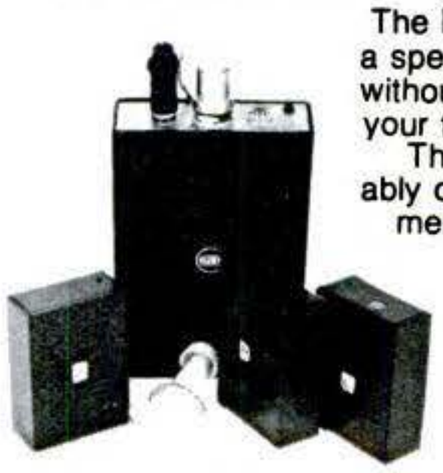
Because SUPER-EAR is the ultimate listening device, you can use it to pinpoint hidden squeaks in your car or the source of mysterious engine noises. Construction experts use it to check for flaws or cracks in buildings.

It Works Anywhere!

Ever put your ear to a railroad track to try to hear the train? Try it with SUPER-EAR. You'll hear that train many miles away. Use it as a powerful stethoscope on yourself, a friend, or a pet. You can even hear a bird's breathing.

The only source for SUPER-EAR is New Horizons. Choose from two models — Model SB-5, with ultrasensitive microphone, $139.95 (two for only $129.95 each); or Model SB-1, with suction-type microphone, $99.95 (two for only $89.95 each).

The **Private Transmitter/Receiver**



The NCZ-10 broadcasts on a special radio band. No one without equipment can hear your transmitted messages.

The reception is unbelievably clear and bright — commercial broadcast quality.

Your receiver clicks into any of three separate channels. In the suburbs the range is up to 2000 feet, and in the city 850 feet.

With your special receiver is an inconspicuous high fidelity earphone. You can put three transmitters in three locations and then switch back and forth, monitoring all three. Someone with an FM or police band receiver can tune his dial all day, but he won't pick up these signals.

With two receivers, you can have a complete two-way system without the inconvenience and annoyance of the semi-public CB channels. The NCZ-10 channels are private.

This professional-quality electronic miracle is easy to use and completely dependable. Monitor your baby's room. Leave a transmitter in an inconspicuous place in your office or your home, and you'll hear anything going on in that room.

One NCZ-10 receiver with one transmitter is $279.95; with two transmitters (two separate bands), it's $379.95; with three transmitters (three separate bands), it's $479.95.

For a complete private communications system, order two receivers, each with a transmitter (we'll send them with different bands). Special high-performance batteries enable you to operate the receiver for 40 hours continuously, the transmitter for 35 hours.

We Absolutely Guarantee!

Use any electronic instrument acquired from us for up to 30 days. If you decide for any reason you don't want to keep it, return it for a 100% refund.

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- Dyna-Mike 9-DX, $149.95 (two for $139.95 each)
- 9-DX rechargeable power-pak, $19.95
- Dyna-Mike A-5, $99.95 (two for $89.95 each)
- Super-Ear Model SB-5 microphone, $139.95 (two for $129.95 each)
- Super-Ear Model SB-1 microphone, $99.95 (two for $89.95 each)
- Voice Changer, $99.95 (two for $89.95 each)
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ALTERNATE-ENERGY ANSWERS

By JAN F. KREIDER

Jan F. Kreider is a consulting engineer specializing in the design and economic analysis of solar-energy and energy-conservation systems. He is the author of several books on solar technology, and a lecturer at the University of Colorado.

How to figure paybacks

What are the virtues of installing new triple-glazed windows? Are they better than double-glazed sash? Would I realize a saving in the heating bill for my 1½-story house?

F. Carleton Dickensheets
Gloucester City, N.J.

The procedure given below can be used to analyze the cost-effectiveness of any proposed insulation feature for a residence. It is based on U-value (reciprocal of R-value), the coefficient of heat transfer of any building element. The lower the U-value, the less the heat loss. To make the calculation, you need the following information: net cost of fuel (delivered cost divided by efficiency), extra cost of the proposed building feature (including applicable tax credits), number of heating degree-days for your location, and the expected U-value improvement with the new feature. For the reader's question, the calculation goes like this:

(1) Double-glazed wood-framed windows have a U-value of 0.55; triple glazing gives a U-value of 0.33. Thus, the change in U-value will be 0.22. (It is assumed that all window air leaks are already sealed.)

(2) If fuel oil is used at $1.25 per gallon in a 70 percent-efficient furnace, the net energy cost is $12.50 per million Btu (there's 143,000 Btu in a gallon of oil).

(3) A glazing contractor quotes an additional cost of $3 per square foot of triple glazing for standard sizes of clear-glazing assemblies. The federal tax credit is 15 percent, so the net cost is $2.55 per square foot (minus any state credits).

(4) The annual degree-days in southern New Jersey are about 5,000.

(5) Finally, the annual cost saving is figured by dividing the product of net fuel cost, degree-days, and change in U-value by a universal constant 42,000. In our example, S = ($12.50 × 5,000 × 0.22) ÷ 42,000 = 33¢ per sq. ft.

The $2.55-per-sq.-ft. window investment saves 33¢ each year. At this rate the windows will pay for themselves in eight years. Of course, if fuel prices increase, the payback will be faster.

Southern vapor barriers

My house has ½-in. gypsum, 2×4 studs, insulation (with a vapor barrier toward the inside), and wood siding. I want to remove the wood and add either ½- or one-in. insulation board. What thickness do you recommend? Should I use an insulation board that includes a vapor barrier?

W. C. Sinclair, Shreveport, La.

If you're going to the trouble of removing your siding, add an inch of board. If polyisocyanurate is used, the R-value addition will be about 7.2. The rule on vapor barriers is to place them on the warm side of the insulation. In Shreveport, unlike most of the country, this is the outside.

Heat-pump boost 1

In Wisconsin, many of the winter days are below the 10-to-20-deg.-F temperature range in which an air heat pump operates effectively. Would it be practical to build an inexpensive greenhouse around the outdoor condensing unit of the heat pump to heat the air with solar energy?

Ted W. Ernst, La Crosse, Wis.

In principle, this approach will work if the greenhouse is large enough to produce sufficient heat. There are two practical considerations, however. First, if the heat pump is to work properly when the sun isn't shining, some automatic method of opening the greenhouse is needed to provide outdoor air to the evaporator; otherwise the greenhouse will be cooled excessively and the heat pump will not operate. This air-control feature must also open the greenhouse when temperatures rise above 65 deg. F to control compressor-head pressure. Second, solar heat may be produced when the heat pump is off. A storage system is therefore needed to match continuous solar-heat production to intermittent heat-pump operation.

Heat-pump boost 2

I am planning to install the outdoor unit of a heat pump on a heat-absorbing base and under a reflecting canopy. The canopy would permit the lower winter sun to warm the base while shading it from the higher summer sun.

E. Rimmi, Ulster Park, N.Y.

This is a good idea. Sunlight striking the outdoor unit in winter will improve performance. Likewise, shading the unit during the summer season will boost performance in the air-conditioning mode. However, be sure that the structure is open so that breezes are not obstructed.

Ins and outs

I know that if you paint a wall black it will absorb more solar energy than a white wall, but is it also true that a black wall will give up more of its heat at night? What would be the net heat gain over loss for a black wall and white wall in January?

Kenneth Thomson, San Francisco, Calif.

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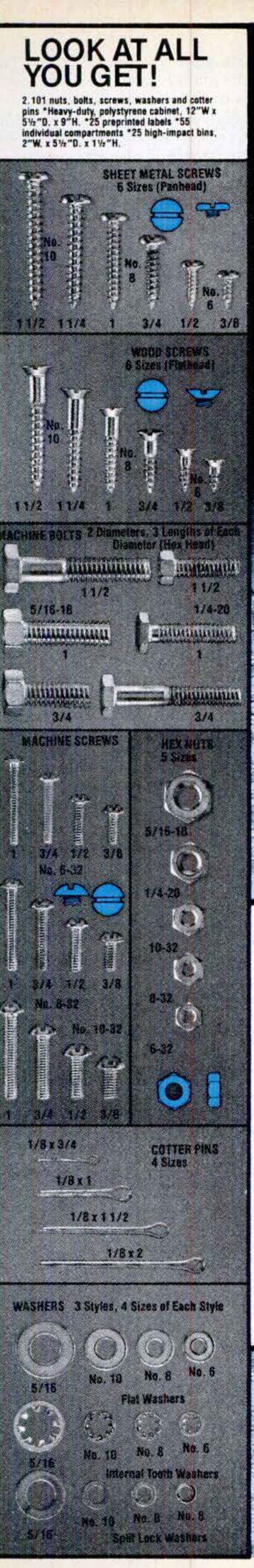

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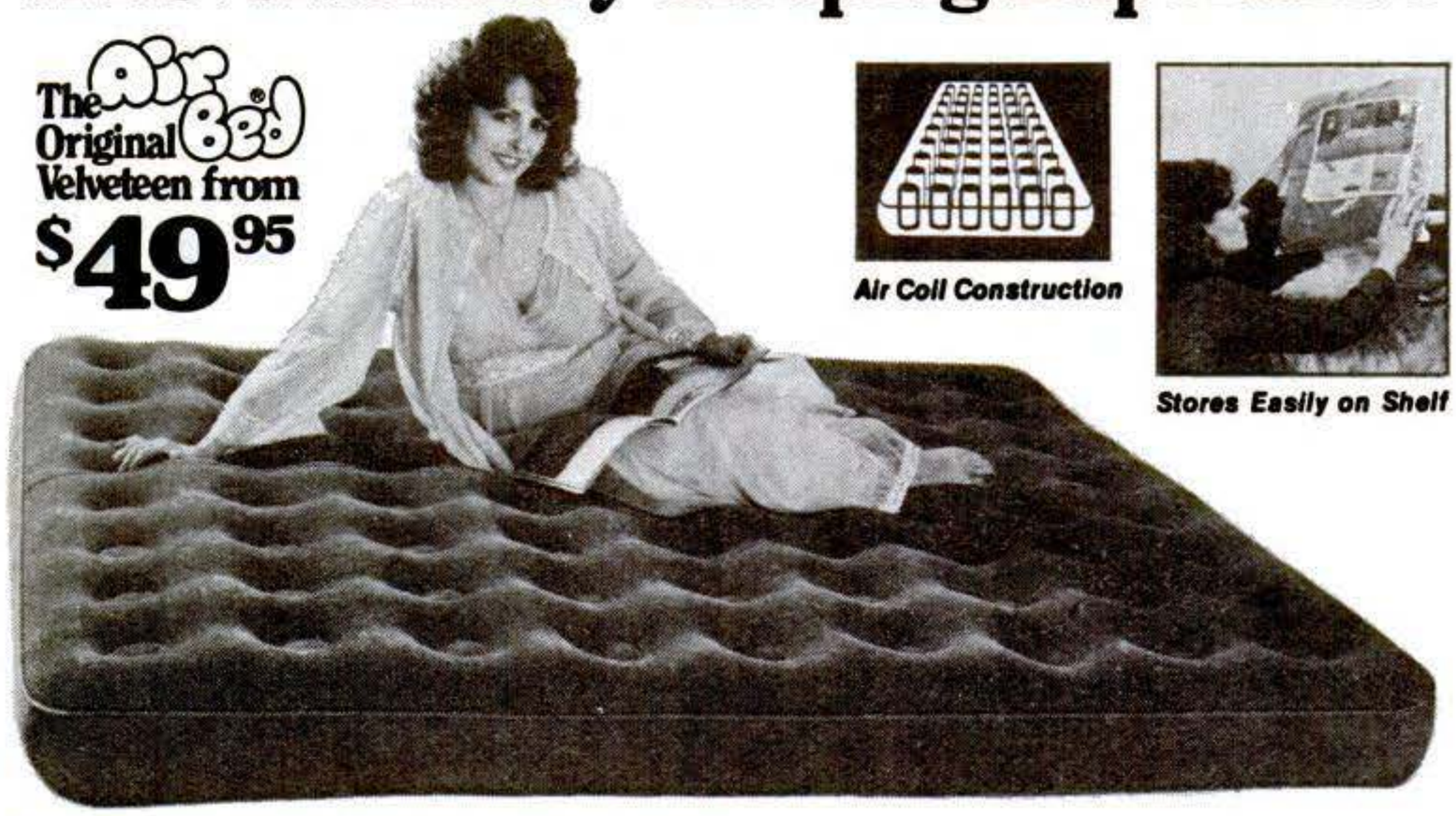

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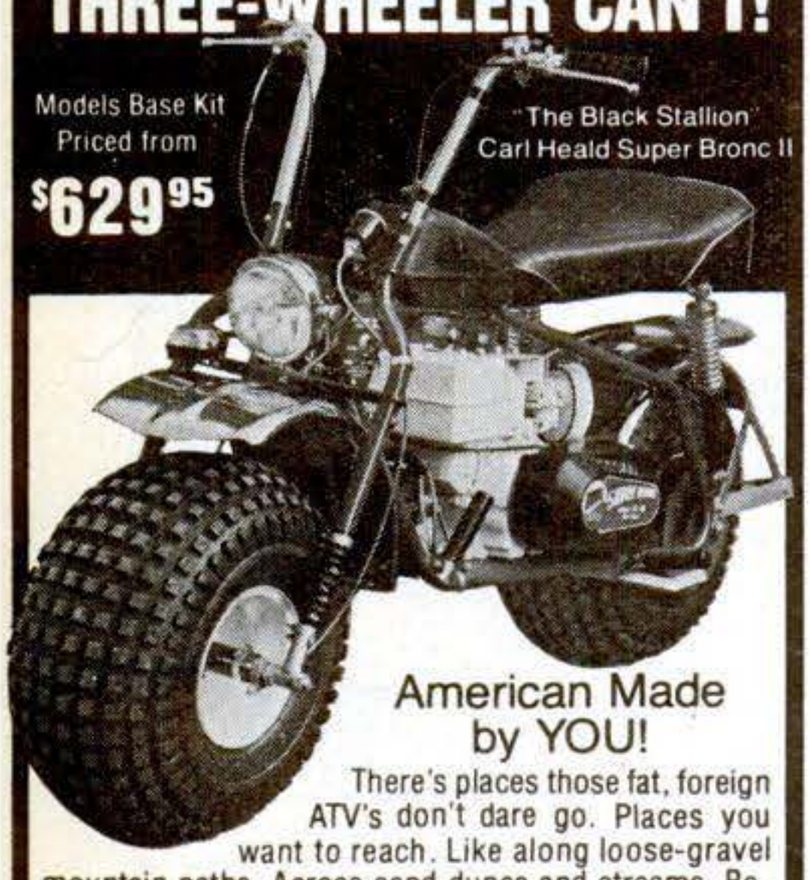

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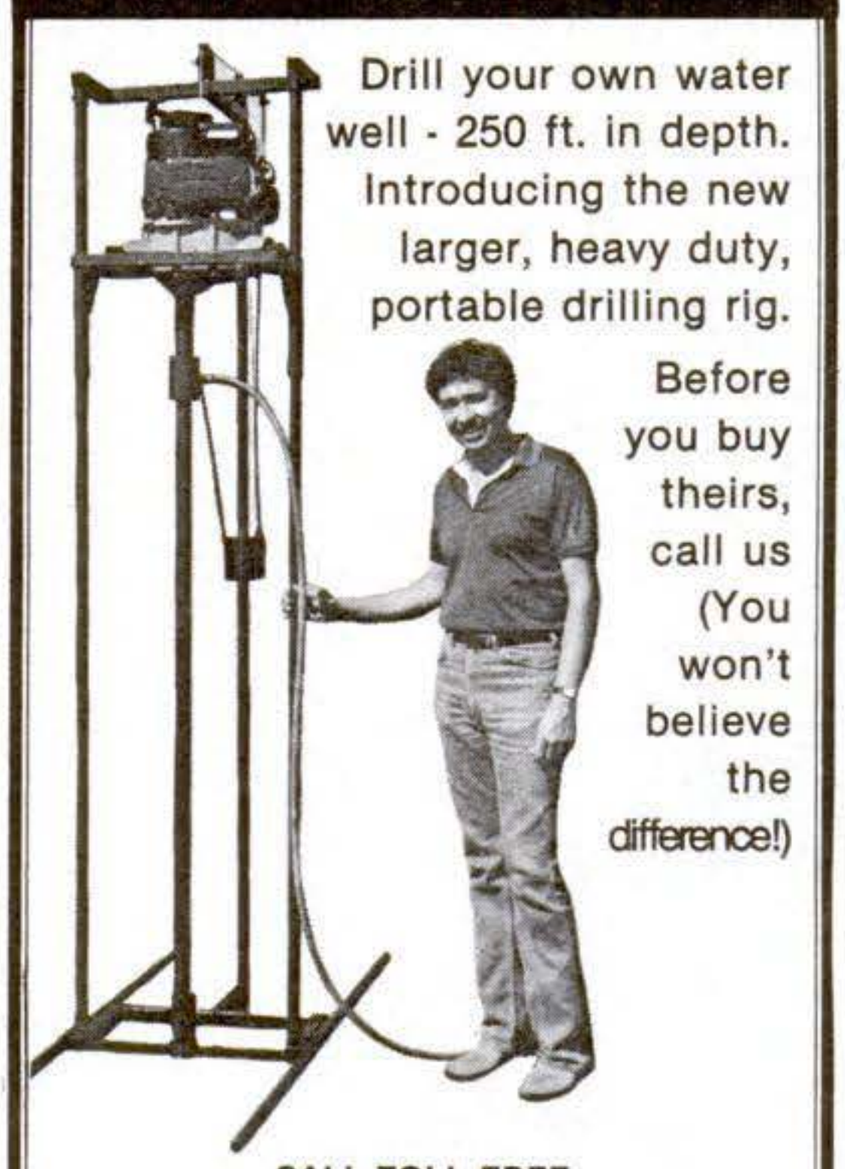

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Alternate-energy answers

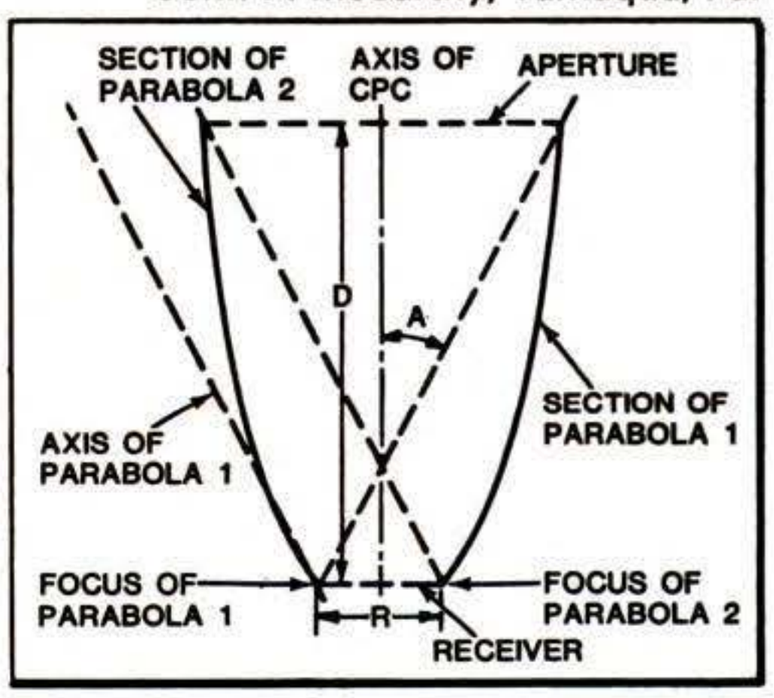
[*Continued*]

This question is an important one, but the complicated phenomena involved preclude a short answer. Dark-colored surfaces absorb more sunlight than light ones because their absorption characteristics closely match the spectral characteristics of radiation from the sun (a 10,000-deg.-F heat source). However, once sunlight has been absorbed on a wall, it is converted to low-temperature heat. The radiation heat-transfer properties of surfaces at low temperatures are vastly different than the properties of the same surface at high temperatures. Aside from this, heat is also lost from outer walls by convective heat transfer. It has been found, however, that all such details of wall-surface preparation have little effect on annual building heating requirements if the wall's R-value is above 12.

Super concentrator

I plan to build a compound parabolic concentrator similar to the one described on page 30 of your July '82 issue. Using the method given in your May '82 column, I would construct two parabolic curves side by side from the same directrix and with the same focal distance. The two focal points would be separated by, say, half the length of the focal distance. Will this work, or is there more to it?

John P. McCarthy, Tamaqua, Pa.



There is more to it. In a compound parabolic concentrator, the axes of the two parabolic segments are rotated toward each other by a certain amount (angle A in the drawing). The angle used depends on the amount of concentration desired. The concentration ratio C is equal to the inverse of the sine of angle A. Most CPCs use concentration ratios of between three and 10. Another important detail is the proper depth (D). A shorter depth will result in fewer reflections and higher concentrations for the same receiver size (R). For optimal depth, use this formula:

$$\left[\frac{C+1}{4}\sqrt{C^2-1}\right]R.$$

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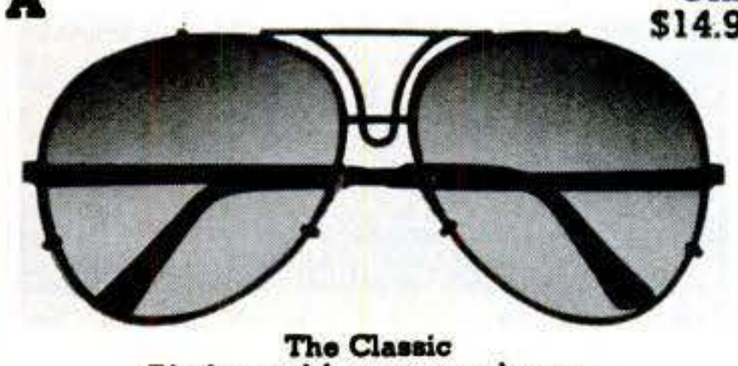

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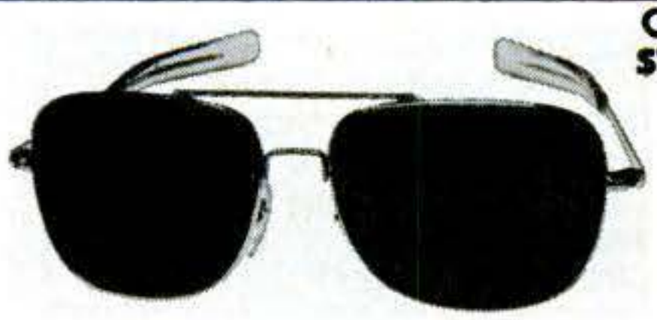

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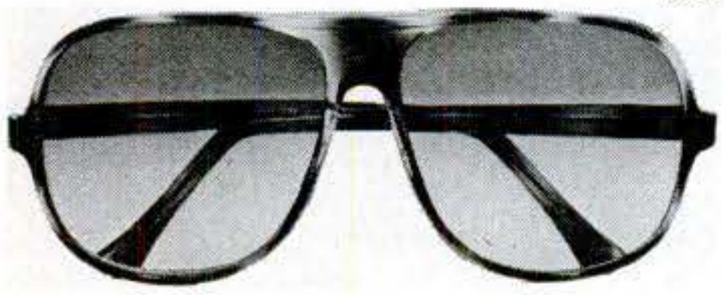

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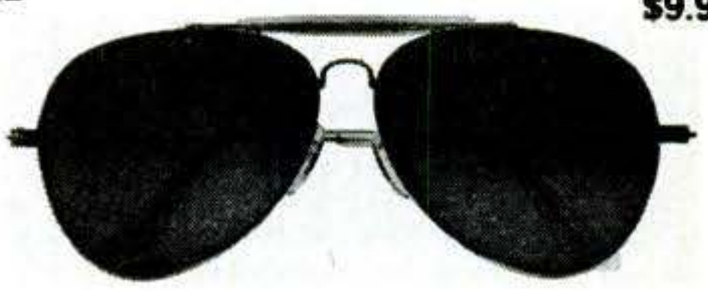

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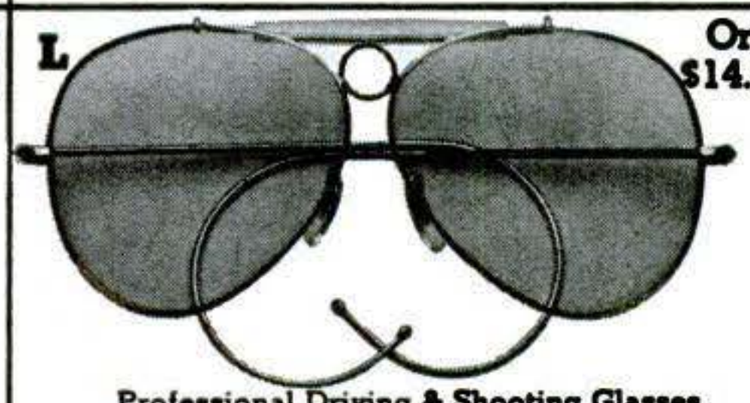

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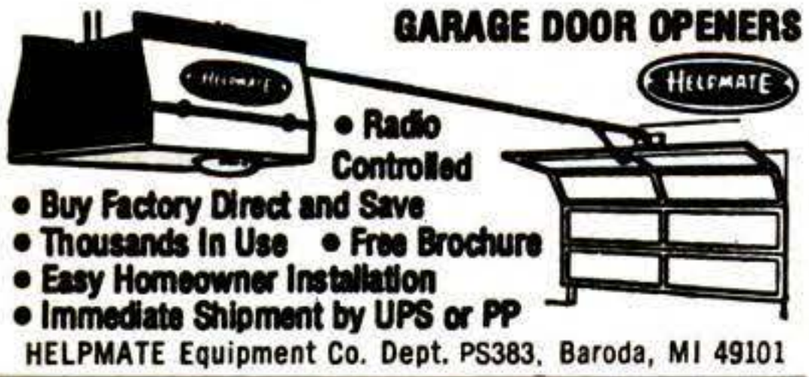

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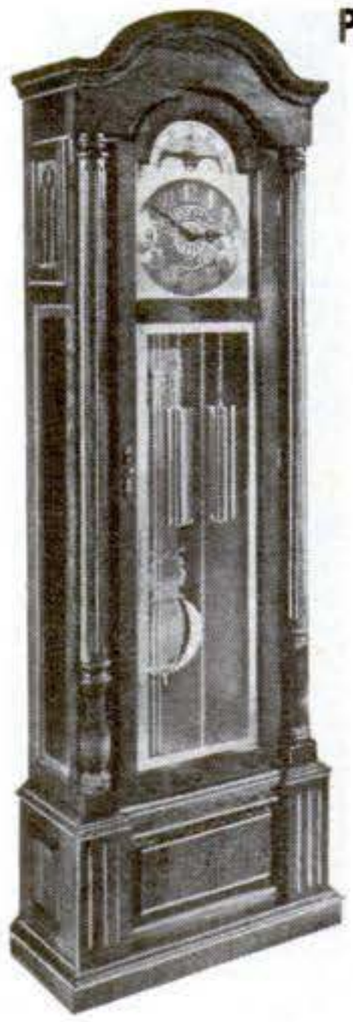

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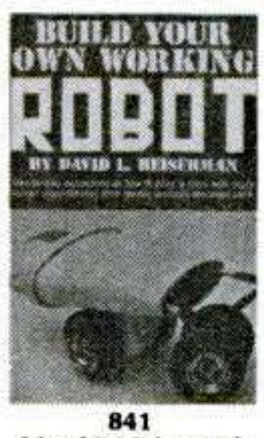

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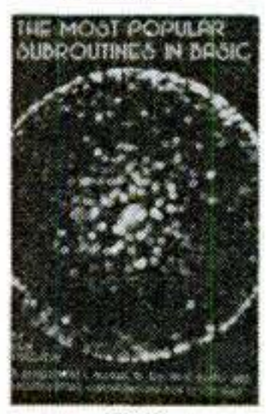

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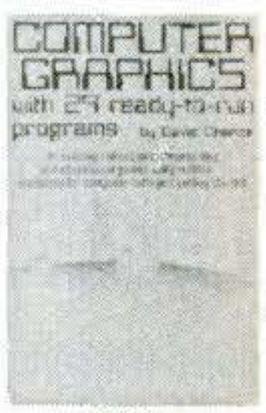

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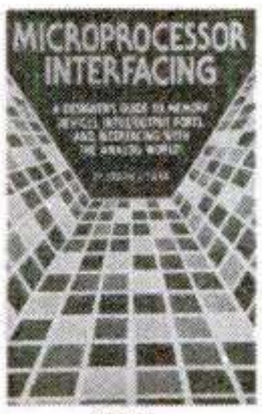

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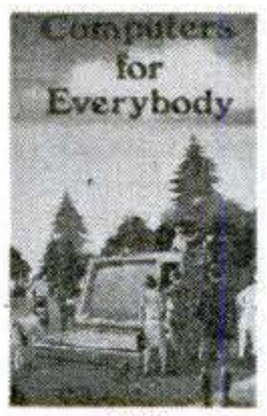

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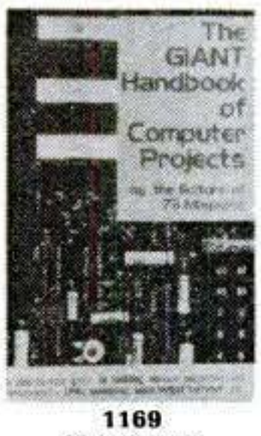

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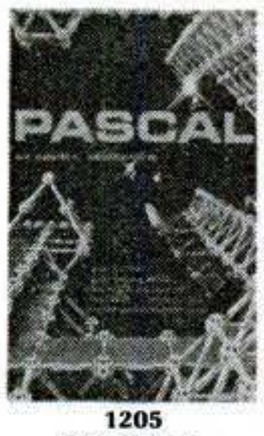

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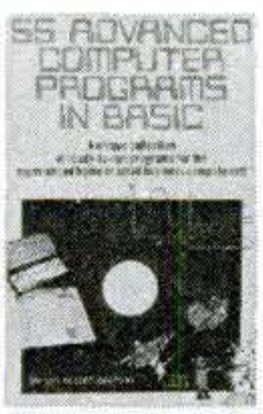

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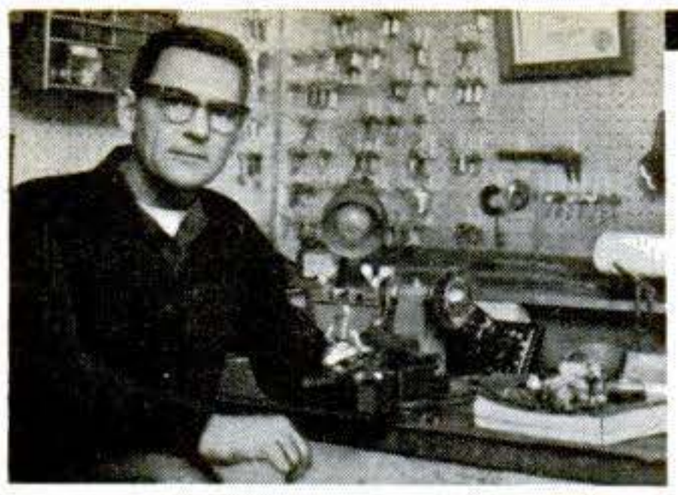

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4. Call factory at same toll-free number and place order for columns to be shipped immediately from stock of 50,000. Use credit card or mail check.
5. Schedule Saturday morning do-it-yourself project.
6. Columns will arrive in approximately 10 days.
7. Arrange for moral support, 2 soft drinks, 1 can elbow grease, hammer, saw, level, and jack.
8. Follow directions and install columns on Saturday morning, eat lunch, then play golf with friends.

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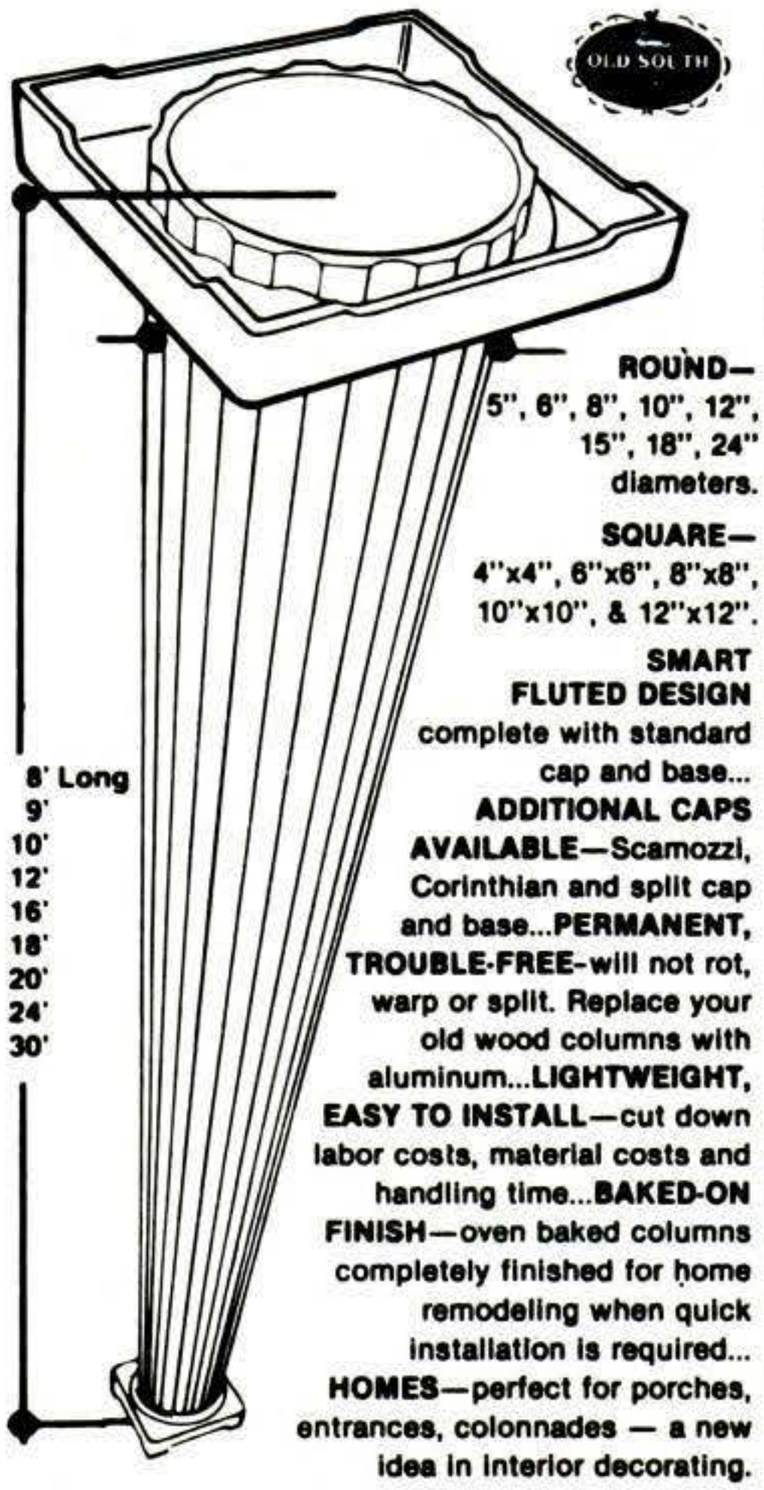

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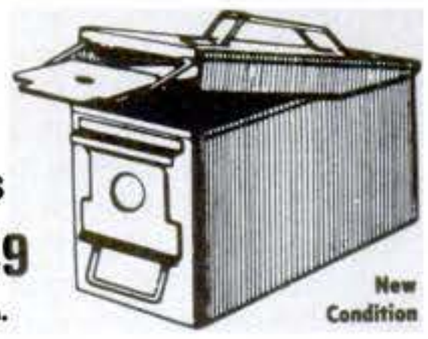

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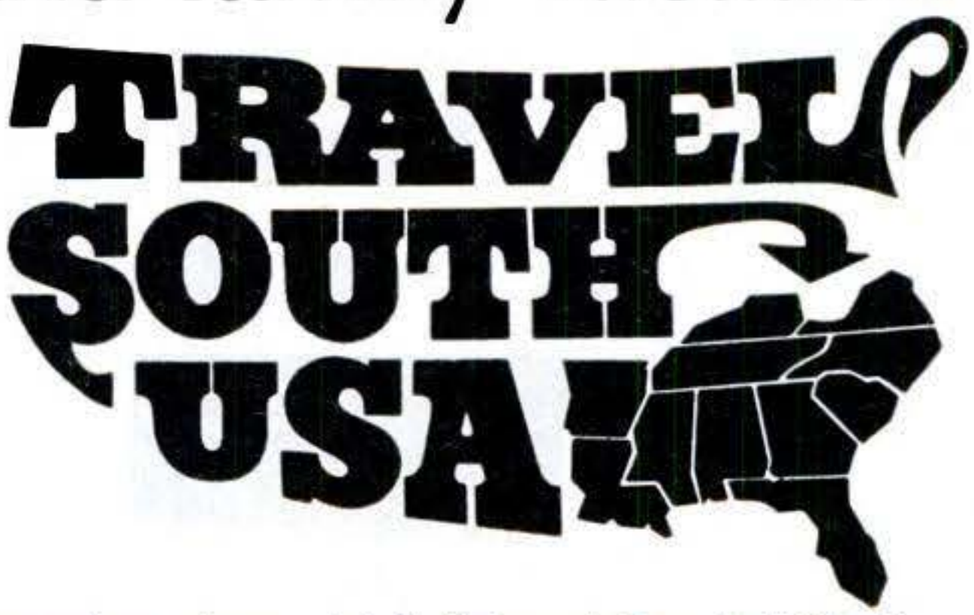

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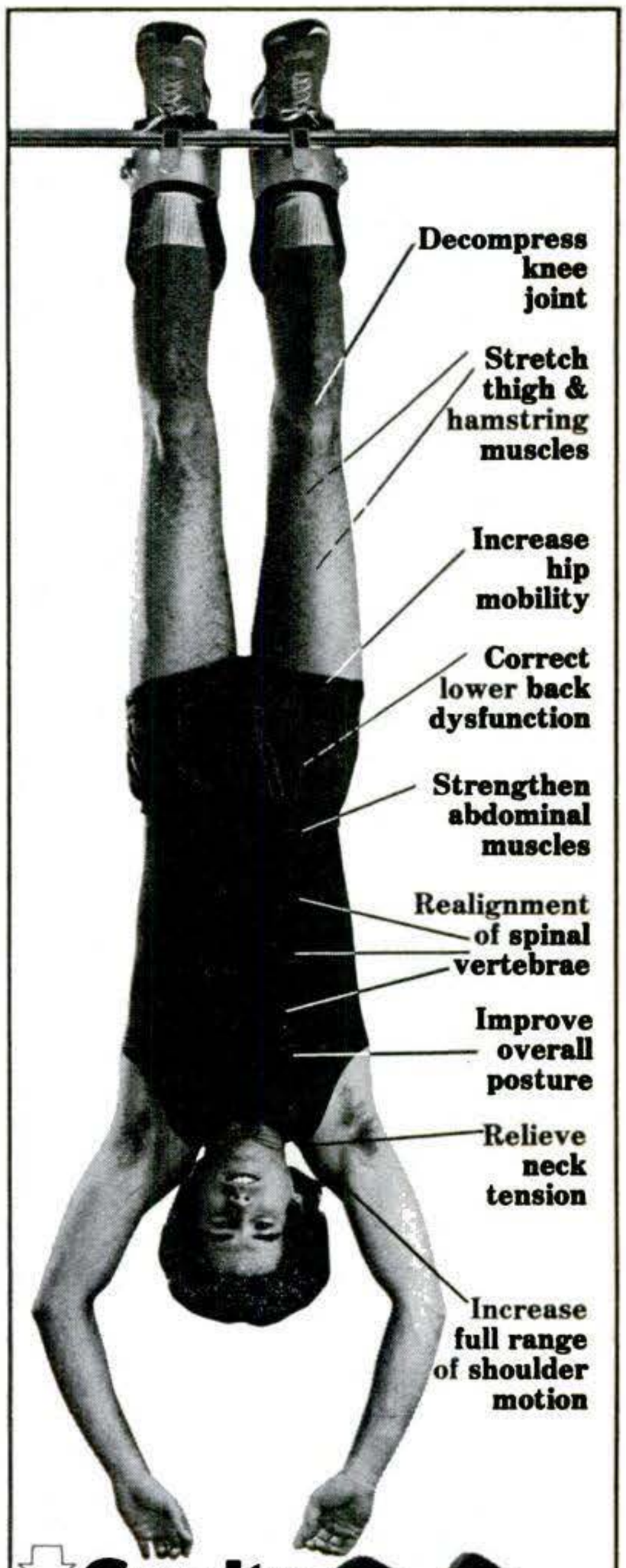

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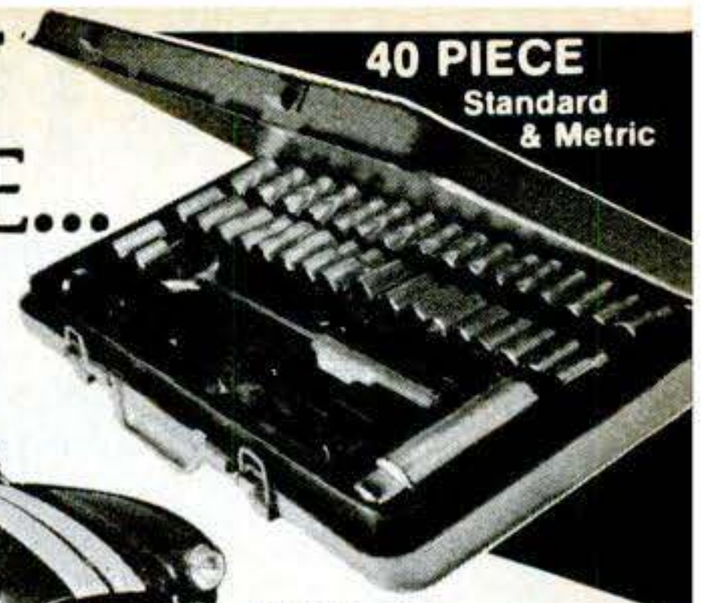

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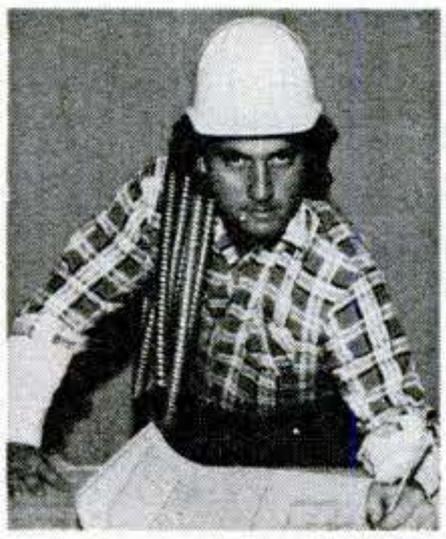

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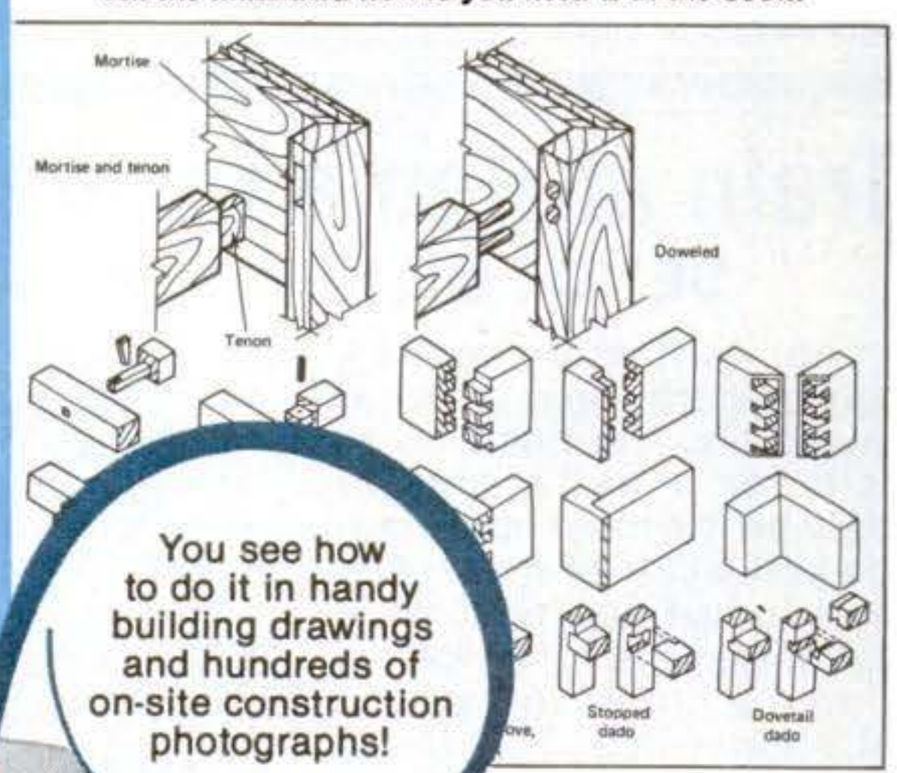

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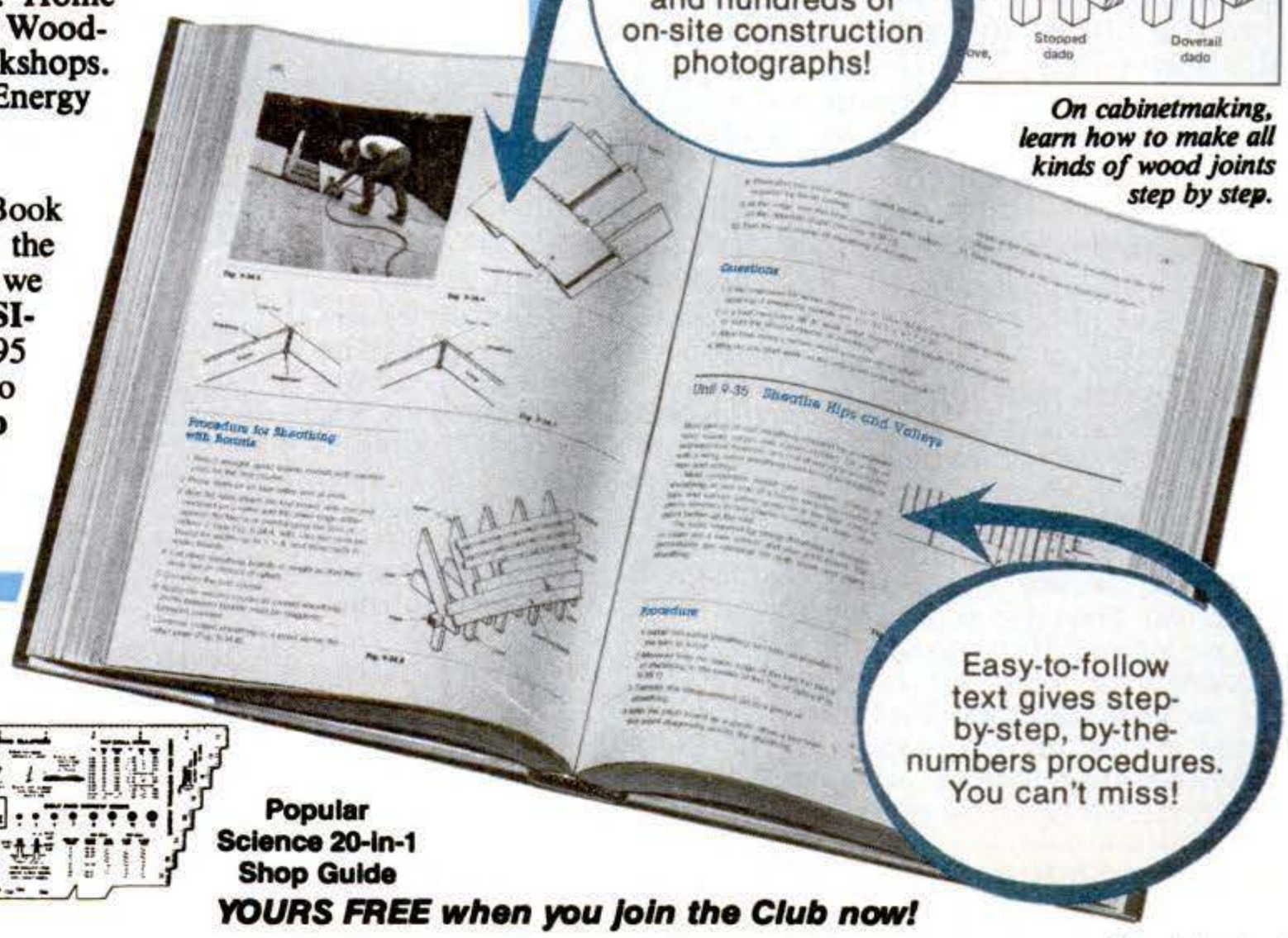

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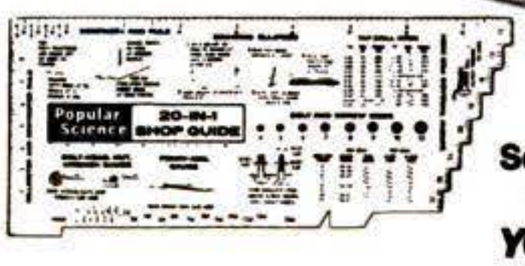

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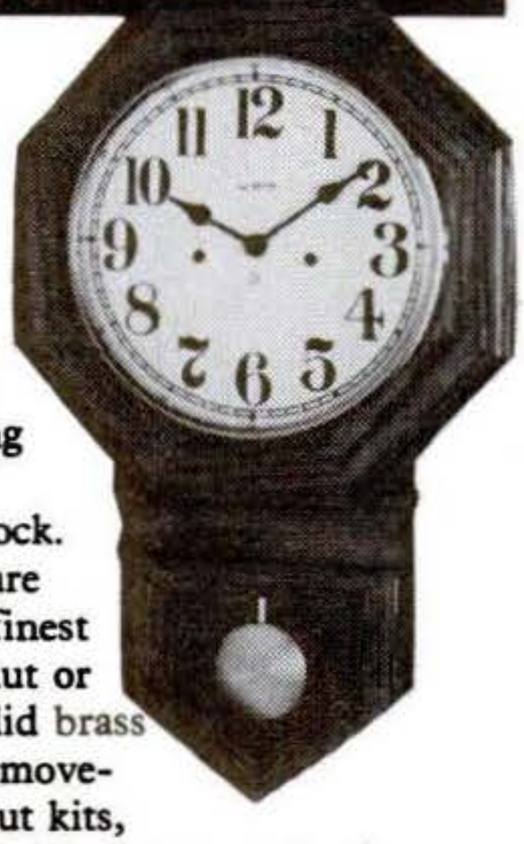

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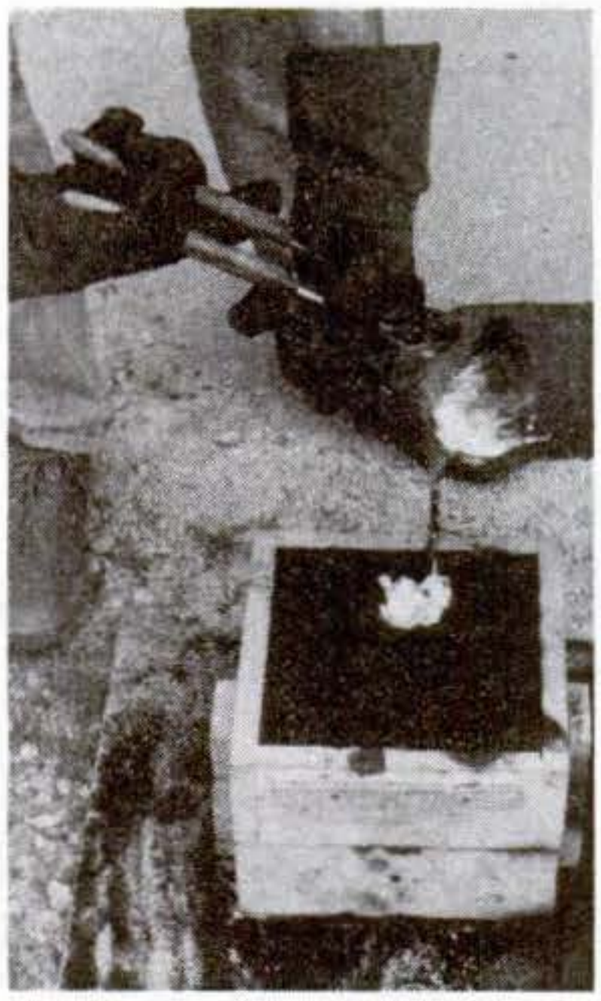

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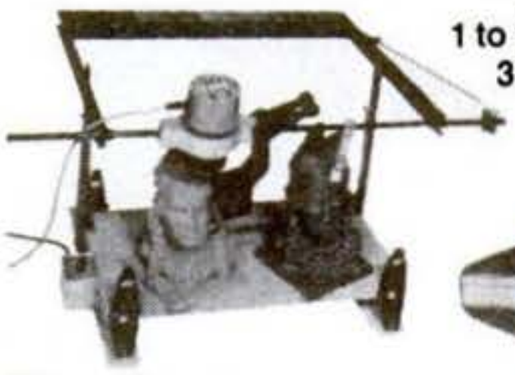

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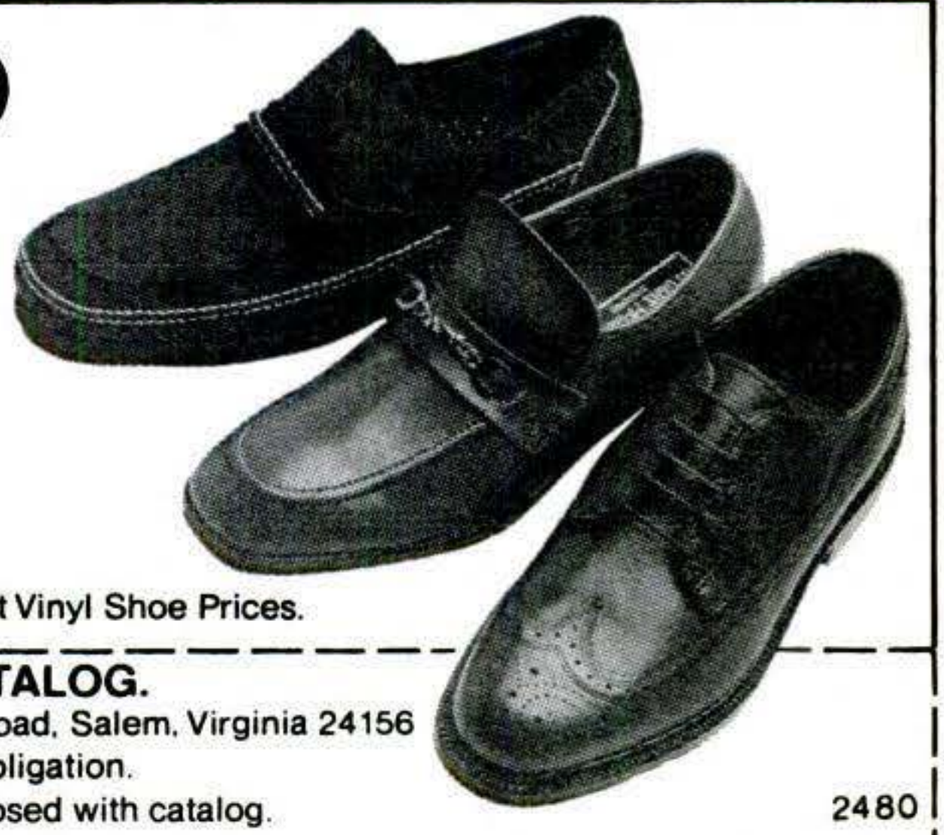

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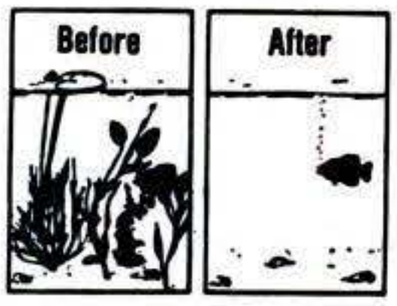

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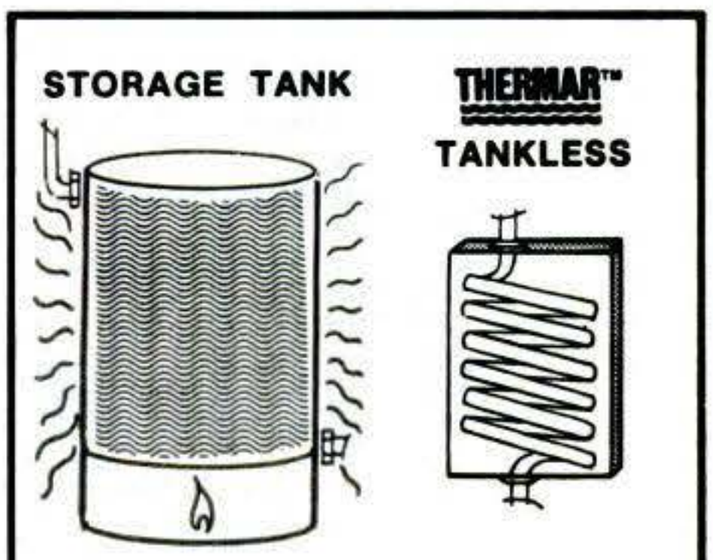

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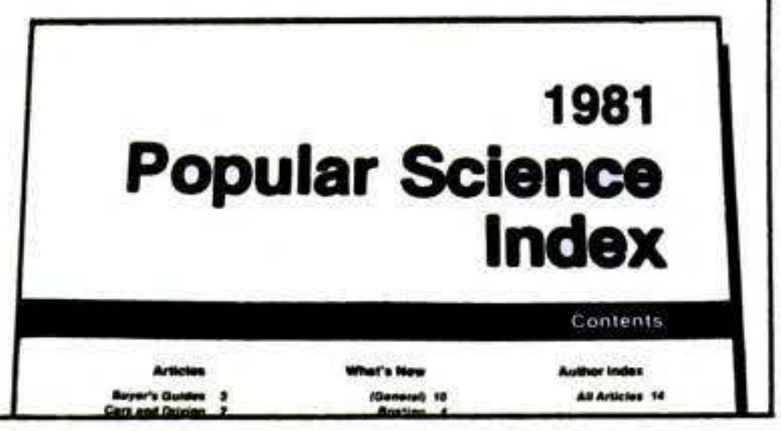

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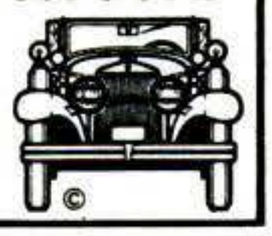

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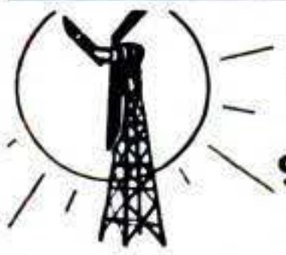

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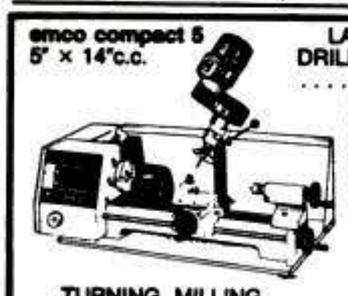

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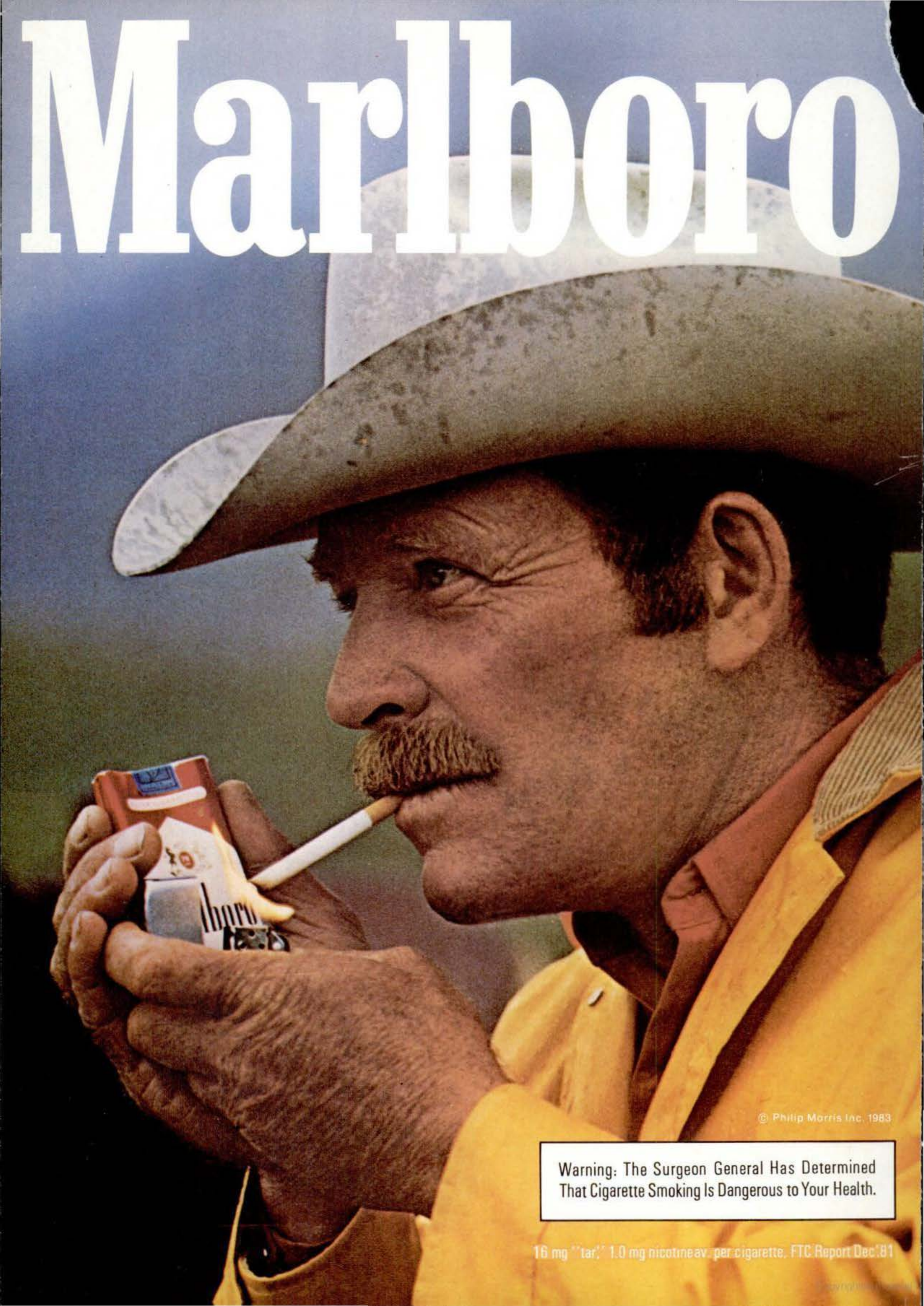
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